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Progress and Organization of Spraying against Supari Koleroga.

(*Phytophthora arecæ*)

BY

M. J. Narasimhan, B.A.,

Senior Assistant Mycologist.

As early as 1908, spraying with Bordeaux mixture as a remedial measure against the *Koleroga* disease of arecanut, was first introduced in the *malnad* areas. The local remedy for the prevention of the disease consists of covering bunches with *kottês* (or the flower spathes) or enclosing them sometimes in *Karda* grass (*Andropogon contortus*). Apart from its doubtful value, this method entails considerable labour by way of preparation of the *kottês* which is generally attended to by the members of the family, and by way of tying of the *kottês* over the bunches, which can be done only by people trained in the work, these being either professional climbers from the Canara District or often the garden owners themselves. Only those who have seen this work can appreciate the nerve of these men, at work, during the heavy monsoon, passing from tree to tree with a swinging movement and wrapping the bunches of one tree from the top of another.

Propaganda Work.

For men, who have been accustomed to this sort of hard work, spraying must be an easy work to do, only the owners must be convinced of its efficacy. In the beginning a large number of demonstrations were conducted in gardens of Sagar, Nagar, Tirthahalli, and Koppa taluks. About 100 to 300 trees were sprayed in various gardens under Departmental supervision, the spraying materials and labour being supplied to garden owners free of cost. These demonstrations were carried on year after year, which somewhat convinced some of the people at least, of the beneficial effects of spraying. But demonstrations on patches of gardens never convinced the people as it would have done if the entire garden were sprayed, for in that case, the garden owner could value the benefit by the increase in total output. In fact work practically stopped in Koppa and Nagar taluks, in spite of a large number of demonstrations. Then the Department took up spraying large blocks of gardens of about 40 to 50 acres one in each taluk. Materials and labour were supplied by the Department, and the spraying was conducted under the supervision of the Departmental staff. The gardens were sprayed twice, once during the season in June and later during September when the nuts were large in size ; the cost of the first spraying was charged to the people, that of the second spraying was borne by the Department. This sort of undertaking taxed to the utmost the vigilance of the staff, as not only a large area had to be sprayed within the short period of breaks in the monsoon but controlled against attacks of the disease later on. The work of second spraying was always a difficult one, owing to the later rains, when nuts began to drop here and there over an area of 50 acres owned by about 15 people. The presence of the Departmental staff on the spot was extremely necessary in order to direct the operation to the various centres of outbreak, or at least to give soothing words. The writer had occasion to find these of great value in extreme cases.

The outcome of this work was that people in the area were fully convinced that *Koleroga* could be warded off by spraying. Further, a band of local men, who were engaged for the season as temporary staff received thorough training in the preparation of the mixture and repairing of sprayers. This was a great asset to the Department, as these men were utilized later in the extension of the work. After all,

the garden owner will lend a more willing ear to the words of a local man than to the best persuasive language of a Departmental Officer and gains confidence in handling the sprayers when he sees one like himself repairing it. As a result of spraying large blocks of gardens, a large number of applications were received from garden owners for getting their gardens sprayed through Departmental agency. The Department coped to the best of its ability with the demand for help, but all the while it was felt that it would be impossible to extend our help to all the applicants. Later on, the temporary staff were posted to work each over an area comprising 5 to 10 gardens. The work progressed very well, till we were faced with difficulty of supply of materials. Apart from the difficulty of importing sprayers from Germany during the War there was always the difficulty of transporting the materials during the rainy season. Garden owners in interior villages had to stock their requirements before the monsoon, owing to the impossible nature of rivers and jungle streams during the rains. At the same time, they would never like to over-stock materials and pay for them. They would rather prefer to purchase materials in small quantities enough to spray as large an area as the rains would permit. In order to give facilities for this sort of purchase, small depots were opened in interior villages where the materials were stocked early in the season. These sub-depots are always opened in centres which are accessible for transport during the rainy season and where at the same time, the spraying materials are in great demand. As a result of this arrangement many new people took up spraying work, from the *sowcar* owning a large estate down to the poor man with a small holding of eight rows of trees. At present we have 20 such sub-depots as these all over the affected areas.

From a small beginning by way of spraying patches of gardens here and there free of cost, the work during the last ten years has progressed to such an extent that, on an average, nearly 6,000 acres of garden are sprayed annually and materials worth about Rs. 30,000 are sold in a year to the garden owners by the Department, at present. Of course, there are very large areas yet to be protected from the ravages of the disease and the Department has been doing its utmost to push the work. But at present we are faced with a new difficulty which, if not set right, may prove to be a serious set-back to the work. It is well known that the garden owner is rich in December

with the prospect of harvest, and poor in June having spent all his money for repayment of debts, on marriages, etc. Government have been gracious enough to allow him credit for the purchase of spraying materials to protect his crop. But the repayment of arrears is regulated by such rules that the convenience of the garden owners is not taken into consideration. This, in my opinion, has set back the progress of the work during recent years.

Attempts are being made at present to form Co-operative Societies in rich areca areas with the single purpose of selling spraying materials. One such society is in the course of formation. Granted that such societies thrive well, their future possibilities are great. Perhaps, it is too sanguine at present to expect them to grow into areca trading societies which will free the individual from the baneful influence of the local *sowcar* to some extent.

Experimental Work.

Bordeaux mixture was long known to be a preventive against fungus disease but it had to be modified when used against *Koleroga* by the addition of an adhesive to prevent washing off of the mixture by the heavy rains. The adhesive which was used at first was made up by boiling 2 lbs. of resin and ½ a lb. of soda ash ; when this adhesive was added on to the spray mixture at the rate of one gallon of adhesive to 24 gallons of spray, it was found to stand even against the very heavy rains of Agumbe. The chief drawback of this adhesive is that it takes nearly an hour for preparation, and it requires some practice as in the case of jaggory boiling. Owing to the short breaks in the monsoon and the uncertain weather, the garden owners used to feel valuable time slipping by during the preparation of the adhesive. In addition, the adhesive mixture sometimes got lumpy owing to the insufficiency of soda added or to the presence of stray copper sulphate crystals in the resin. The writer had come across instances in the early days, of people swearing as the resin soda mixture would not dissolve and blaming the oven, and of some who were caught in the act of breaking cocoanuts under the areca tree to propitiate the deity, till he (the writer) came to their rescue.

Experiments were conducted during the year 1922 on the Marthur Farm to test the efficacy of casein as an adhesive, half a pound of casein being used for 25 gallons of the mixture. It was added in the

form of lime-caseinate and took only ten minutes for preparation without involving any boiling as in the case of the resin-soda adhesive. Later, trials made in private gardens convinced the people that the use of this adhesive not only facilitated the work on account of its easy preparation but also reduced the cost. During the last four years, the use of casein has been very widespread and casein has practically displaced resin and soda in the preparation of the mixture. More recently a further modification of the mixture was made by the addition of potash-alum and reducing the quantity of copper sulphate and lime. This mixture was used in Germany during the War owing to the high cost of copper sulphate at that time. It has been given a thorough trial for the last three years in about 60 gardens and has been found to be quite effective. Its use has reduced the cost of spraying to Rs. 2-1-0 per acre as compared to that of casein-bordeaux which costs Rs. 3-10-0 per acre. During the present spraying season a large number of garden owners are giving this mixture a thorough trial. The main object of the Department in making trials with various mixtures is to arrive at one which will be easy of preparation and which will reduce the cost of the chemicals to the minimum.

Another line of investigation which was taken up at the commencement of our work in the *malnad* was to find out whether the disease could be stamped out in a garden after spraying for three consecutive years. Work along these lines was taken up in four gardens, situated in different areas. The results appeared promising only in one isolated garden at Agumbe. The garden at Kerodi, Tirthahalli taluk, was free from disease for two seasons after the treatment but was found to be affected during the next season. In the other two gardens the disease was virulent when left unsprayed during the fourth year. Since it was first thought that these stamping out experiments in individual gardens did not prove of value, owing to the infected gardens round about and that the disease might have been carried by means of some agency, similar observations were made on large block gardens. In a large area of 55 acres which had been sprayed for five consecutive years a central block was chosen for observation during the sixth year to see if the disease would appear there if that alone were left unsprayed. The results were disastrous. Since the investigator was the garden owner himself, the Department did

not come in for any blame, but on the other hand, it brought into prominence the value of spraying.

These observations made it clear that the disease could not be stamped out even after some years of spraying. If the disease could not be stopped by spraying the affected areca trees, where then are the germs likely to lurk during the hot season ? This opened a new series of problems. As early as 1912, the resting stage of the fungus, adapted for tiding over the hot season was found on nuts artificially infected in the laboratory. But so far examined, these have not been definitely made out on the fallen diseased nuts.

On particular attention being paid later on to the plants round about and in the gardens, it was found that a large number of plants such as sandal, jak, wild figs, etc., were affected by a similar disease. The garden owner now knows that when the sandal trees round about his gardens begin to shed their leaves during the rains, the time of outbreak of the disease on areca nut is not far off. In the absence of cross inoculation experiments, it cannot be stated definitely that the diseases are identical and that the disease on sandal which appears first is carried on to areca, but the observation mentioned above is of value as a sort of forewarning. A study of these diseases is of immense value in relation to the outbreak of *Koleroga* on areca nut, and will be taken up shortly.

The benefits derived from spraying have been estimated at many lakhs of rupees over an area of 6,000 acres. It is difficult to estimate the figure correctly as the outbreak of the disease in the same area, if unsprayed, varies in virulence. In a garden of five acres which may be calculated to yield normally 150 maunds of areca, the yield will be reduced as a result of the ravages of the disease to about 90 maunds and in case of severe attack to about 40 to 50 maunds, not to speak of a large number of trees being killed. Estimating the loss in money value the garden owner loses a crop worth Rs. 720 to Rs. 1,200 valuing areca at Rs. 12 per maund. Confidential talk with a *sowcar* elicited the fact that in a certain *Hobli*, in one of the *malnad* taluks, which was indebted to the extent of $1\frac{1}{2}$ lakhs of rupees, four years after the spraying work, the level of the debt had sunk down to 60,000 rupees. Some of the bad debts too were collected. I am not sure if the *sowcar* is altogether pleased with the spraying work and its effects but he should be glad any way, that owing to the

spraying he can attach some crop at least from the garden of his hopeless debtors.

On a sprayed area of about 6,000 acres, the value of the crop saved may be estimated at 8 to 10 lakhs of rupees. Of course, the area covered thus far is nothing compared to that which is still left unprotected from the ravages of the disease. The total infected area in the *malnad* is estimated at 17,000 to 18,000 acres. Leaving aside areas which are neglected as those under litigation, and those in which for some unknown reason the disease does not appear though situated in the ghat area, it will be seen that a large area has yet to come under the spray. There are now about 3,000 sprayers in the *malnad* villages. We look forward to the day when every house will have sprayers and every areca tree will be sprayed.

A great deal has been said about the characteristics of the Indian ryot, his drawbacks, and his conservative nature. The writer's experience for the last ten years of the *malnad* garden owners in thousands has convinced him that at first they are very conservative and rightly so. If you are going to suggest any improvement, agricultural or any other, they never appear to fall readily to it. It requires a good deal of time for them to be convinced but once they are convinced, they adopt the improvement with great enthusiasm. Some of the intelligent garden owners have been instrumental in the introduction of certain alterations in the parts of the sprayers, alterations which were readily adopted by the manufacturers. The large number of experiments which the garden owners themselves conduct, with modifications of the mixture, is unbelievable and sometimes disastrous too in results. It is not common knowledge in towns but it is in many of the *malnad* villages that whitewashing of the walls can be done more quickly and efficiently with the sprayer than by the usual method and that the addition of casein to the lime prevents the wash by the rains. If a real improvement advocated by us does not catch on it is not due to the conservative nature of the people, it only means that our propaganda work is not convincing enough. Once they are convinced, they are able to overcome the working difficulty and to suggest improvements on our own methods.

Areca Manurial Experiments on the Marthur Farm.

BY

B. Narasimha Iyengar, B.A., Ph.D.,

Agricultural Chemist.

The first *series of experiments to find out the manurial requirements of the areca palm were started on the Marthur Farm in the latter part of 1920 and continued on the same plan for 3 seasons. About a third of the number of rows of trees were treated as checks, *i.e.*, they were given only a small general dose of cattle manure and leaf mulch every year. The various treatments and the yields obtained from them during the different seasons of 1921-23 are given in the table annexed.

During the whole period, ordinary superphosphate and sulphate of potash have been used as sources of phosphoric acid and potash respectively. As seen from the treatments mentioned in the table, sulphate of ammonia and groundnut oil-cake have been tried as sources of nitrogen. The quantities of manures applied per tree either singly or in combination have been as follows : 0.25 lb. of nitrogen in one of the two forms used, 1 lb. of phosphoric acid as superphosphate and 0.2 lb. of potash as sulphate of potash.

The manures were applied round each tree and were mixed with the soil. The time of application was usually in the month of November soon after the large main harvest. A few days after the application of artificial manures, about 5 to 10 lbs. of cattle manure according to quantity available was put round each tree including those in the check plots and covered over with the usual leaf mulch.

Details of yields obtained in the various years are given in the table and only average figures for the 3 seasons are given below, calculating the yield of dry nuts per acre on a basis of 400 bearing trees :—

Treatment.	Yield in lbs. per acre.
Check or no artificial manure	590
Groundnut cake	757
Cake and Super	733
Cake, Super and Potash	904
Ammonium Sulphate	778
Sulphate and Super	760
Sulphate, Super and Potash	803

* For details of these experiments, *vide* Vol. V, No. 2 of this Journal.—*Ed.*

The yield of 590 lbs. or slightly over 20 maunds per acre from the check series represents the average yield for the Shimoga District —the locality in which the farm is situated, as given on page 2 of the Departmental Bulletin on the ' Cultivation of the Areca Palm in Mysore'. The maximum average yield of 904 lbs. per acre during the period has been from the series manured with cake, super and potash and represents an increase of more than 50% over the check series.

The effects of potash are clearly seen in the cake series, but not in the sulphate of ammonia series. The simultaneous application of 3 soluble manures in the sulphate series may have brought about some undesirable changes in the concentration of the soil solution making it difficult for the plant to properly assimilate the materials needed. The point can only be cleared up by applying sulphate of ammonia some time after the application of the other two manures.

From figures given above, it will be seen that in both the series of experiments the addition of superphosphate alone to either cake or ammonium sulphate has not contributed any increase in yield. In order to find out the necessity or otherwise of phosphatic manure, the experiments were remodelled in 1924. The former check series were manured as detailed in the table annexed, and the manured rows were left unmanured to study the residual effects of manures applied for 3 years continuously.

As before, detailed yields of the above series of experiments for the various years are also found in the annexed table and only average yields of 3 seasons are given below :—

Average yield in lbs. per acre when treated as checks during 1921–23.	Treatment during 1924–26.	Average yield per acre during 1924–26.
628	Am. Sulphate and Potash ..	800
518	Sulphate, Super and Potash ..	767
620	Cake and Potash ..	786
588	Cake, Super and Potash ..	787

The fertility of these rows is also indicated by their yields during 1921–23 when they received no artificial manures and were treated as checks. These variations in fertility may not be due to soil conditions alone, for all the rows do not contain trees of the same age. The presence of these two variable factors makes it rather difficult to

accurately judge the effects of manures applied. Moreover, as some trees which existed in the rows and were bearing during 1921–23 fell down owing to heavy winds of the South-West monsoon each year and new trees have also come into bearing in the meanwhile, the interpretation of results becomes much more difficult and complicated. As the harvest each year has been conducted tree by tree, attempts will be made to take the yields of only those trees which have been bearing right through the period of experiment and interpret the results.

Neglecting the fertility figures for 1921–23 and judging only from the results of 1924–26, the necessity for adding phosphate to the manure mixture for areca is not quite clear. The mixture of cake, super and potash may be said to be very slightly better in its effects than the one containing sulphate of ammonia instead of oil-cake. At any rate the big difference of 100 lbs. in yield in favour of the cake mixture during 1921–23 has dwindled down to 20 lbs. during 1924–26.

Coming now to the residual effects of manures applied during 1921–23, it is seen from figures given in the table giving details of treatment and yields that there has not been any falling off in yield and that the cake mixture series is still ahead of sulphate mixture series by 134 lbs. or nearly 5 maunds to the acre.

Hence it may safely be said that after a garden has been brought into a good yielding state, the practice of manuring it once in three years by rotation is a fairly sound one.

TABLE.

Results of Areca Manurial Experiments on the Marthur Farm, 1921—26.

Treatment, 1921—23.	Yield of dry nuts in lbs. per acre.			Average yield per acre 1921–23.
	1921.	1922.	1923.	
Check	569	535	780	628
,, ...	448	406	578	518
,, ...	612	540	713	620
,, ...	528	490	731	588
Groundnut Cakes	730	686	856	757
Cake and Super	650	697	852	733
Cake, Super and Potash	948	822	942	904
Sulphate of Ammonia	787	697	850	778
Sulphate and Super	727	728	825	760
Sulphate, Super and Potash	803	749	856	830

Treatment, 1924—26.	Yield of dry nuts in lbs. per acre			Average yield per acre 1924-26.
	1924.	1925.	1926.	
Ammonium Sulphate and Potash	765	748	888	800
Sulphate, Super and Potash	643	804	854	767
Cake and Potash	707	710	950	786
Cake, Super and Potash	681	764	900	787
Residual effects of manures applied during 1921—23	756	726	840	774
	802	663	821	762
	988	762	1,073	941
	716	655	769	713
	664	659	777	700
	896	660	865	807

N.B.—The yield of dry nuts is calculated on the basis of 400 bearing trees per acre.

Yellachihalli Sheep Farm and its Work.

BY

Lieut. A. A. Monteiro, G.B.V.C.,

Superintendent, Amrutmahal Department.

While the introduction of improved methods in agriculture was making rapid headway even in the inmost recesses of the Malnad, the problem of improving the wool growing industry in the State was not lost sight of and two farms, one at Hebbal and the other at Yellachihalli, were established to carry on sheep breeding experiments.

An area of about 1,000 acres, about 12 miles from Mysore, was selected for the purpose of locating the farm. This land presents the features of a picturesque high land country, and is of the kind best suited for sheep which prefer short herbage on an extensive range to a luxuriant growth on a limited area. The place was selected by Mr. W. Davison, the then Live-Stock Expert, evidently with the idea of testing the adaptability of the sheep, which always has been and will be a problem in sheep breeding. The first two years were spent mainly in clearing up the jungle and in the construction of buildings. An extent of about 20 acres was brought under cultivation and the rest forms the pasturage. It is obvious that any efforts to be

made in the direction of improving the wool-producing capacity of the sheep and developing the industry must be carried out in a scientific and business-like manner and the most logical plan is to begin with a small or moderate fixed flock of good country ewes and merino rams.

The breeding experiments carried out on this farm are :

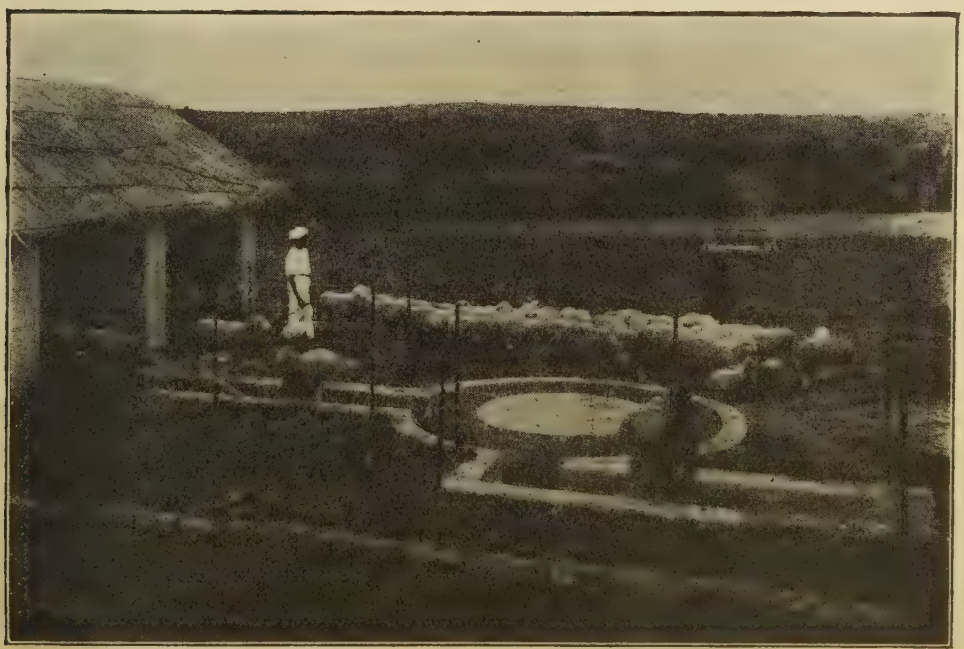
1. Merino rams mated with Mysore ewes.
2. Half-bred rams mated with Mysore ewes.

The results of these crosses have been very striking and the suitability of the Australian Merino for mating with Mysore ewes is established beyond doubt except on the one important side of disease-resistance, where the indications are that half-breds are more susceptible than are the country sheep. Although the progeny of the above give a distinctly superior quality fleece to that by a pure Mysore ram, the results of the system are not likely to be of much use in producing any permanent improvement. The mating of half-breds with half-breds is being carried on elsewhere, and the aim of all these crosses is to evolve a fine type of animal of superior wool-growing capacity which would eventually breed true to type and at the same time be able to withstand the vicissitudes of climate and other adverse conditions. In the meanwhile the surplus male cross-bred stock is introduced into local flocks owned by enthusiastic and enterprising breeders who wish to improve their flocks.

Unfortunately, a large number of cross-bred male stock could not be distributed, and cross-bred ewes could not be had in large numbers to carry on breeding operations on a large scale owing to outbreaks of contagious diseases and other ailments to which sheep are most susceptible. In very many cases, the disease to which they succumbed could not be diagnosed. Investigation of these diseases is engaging the attention of the Civil Veterinary Department. Much experience has however been gained in devising effective treatment for many of the ailments and the mortality has been brought down. The following figures show the mortality that has occurred on the farm on account of all causes, and the degree of susceptibility among the crosses as compared with the country sheep :—

YELLACHIHALLI SHEEP FARM, MYSORE.

At Meal—A flock of cross-bred sheep being fed on concentrates.



Circular Sheep Dipping Bath.—Sheep are dipped at least twice a year to free them from lice.

Cutting a crop of jola for ensilage.—Sheep are fed on ensilage during the summer.

The kind of pasture sheep love.—They prefer short herbage over an extensive area to a luxuriant growth on a limited area.

Year.	Half-Breds.			Quarter-Breds.			Country.		
	Average Strength.	Deaths.	Per cent.	Average Strength.	Deaths.	Per cent.	Average Strength.	Deaths.	Per cent.
1922–23 ..	15	10	66	15	3	20	150	12	8
1923–24 ..	60	35	58	8	2	25	60	12	20
1924–25 ..	70	60	85	15	7	46	156	34	22
1925–26 ..	40	19	47.5	25	5	20	120	10	8
1926–27 ..	18	10	55	47	6	13	142	31	21

In addition to the experiments directly connected with breeding, much experience has been gained with regard to feeding and general management. It has been found that lambing at all seasons of the year is not desirable unless the ewes have abundant grazing throughout the year.

A selected number of ewes are bred systematically once a year. The breeding operations commence soon after a few showers of the *mungar* rains and last till about the end of August. Lambing commences in the latter part of September and continues till about the middle of January. Lambs dropped early in the season (*i.e.*, during the months of September, October and November) thrive better than lambs born later, for the obvious reason that the ewes then find ample grazing. The lambs have shown on an average a birth weight of $5\frac{1}{2}$ lbs. which is practically double that of the pure country lamb, and growth has also been considerably faster than in the case of the country animal.

Lambs that cannot get enough milk from their dams are hand fed. Rams that are set apart for breeding and those meant for distribution among the ryots are looked after with special care and are allowed concentrates and roughages available on the farm.

Jola, sun-flower and horsegram are the important crops grown on the farm. The former two are converted into ensilage which is used for feeding the stock during the summer months. When sufficient water for the purpose is available in the small tank that exists on the farm, irrigated crops and green grass are grown to feed the merinos during the hot weather.

All the animals that are unfit to be retained for further breeding work either on account of disease, malformation, stunted growth, old age or on account of their not possessing the desired characteristics are culled out. This process of culling and the mortality that should ordinarily be expected, do not permit of extensive work in the improvement of sheep outside the Department. Over seventy animals produced on this farm have been distributed, and their performance in rural parts has been satisfactory and has awakened considerable interest in the minds of ryots who have begun to appreciate the improvement from the standpoint of wool production. The following results obtained at different periods indicate the average yield in pounds of wool got by clipping the different breeds of sheep on the farm :—

	Merino Ewes.		Half-bred Ewes.		Quarter-bred Ewes.		Country Ewes.	
	lbs.	ozs.	lbs.	ozs.	lbs.	ozs.	lbs.	ozs.
Average	6	9	1	10	0	14	0	11
Highest	7	8	3	4	1	4	1	6
Lowest	5	8	1	0	0	8	0	4

While the country wool fetches 4 to 6 annas per lb. the wool from cross-bred sheep has fetched from 8 annas to as much as 14 annas per lb. and the wool experts have reported most favourably on the quality of the wool.

Clipping is done on the farm with a hand power machine which cuts close to the skin of the animal thus yielding a greater quantity of wool per clip than the country method of clipping with the shears.

Dipping which is of immense benefit to the fleece and protects the animal from the ravages of ticks and a good many parasitical diseases is done on the farm twice a year. To effect complete eradication of the parasites it has been found beneficial to dip the animals at an interval of ten days after the first clipping. "KYMAC", a preparation of Messrs. Cooper & Co., is found to be most efficacious for this purpose.

A plantation of about a hundred Algaroba plants has been laid out. The green pods of these make an excellent feed for sheep and help to improve their condition. Some *babool* plants have also been planted with a view to feeding the stock in hot weather on the pods

and leaves of these trees as is being done by the local breeders in the Chitaldrug, Tumkur and Kolar Districts.

Sheep bred on these farms were exhibited at the All-India Industrial and Agricultural Exhibition held at Mysore in October 1927. The several demonstrations held on different dates were much appreciated by the people gathered there. As a result of several demonstrations conducted outside the farm, sheep breeding on modern lines has found favour with many of our enterprising landlords.

Large-Scale Trials of Artificial Manures for Sugarcane on Private Lands.

BY

B. Narasimha Iyengar, B.A., Ph.D.,

Agricultural Chemist.

Results of the trial of artificial manures on a large scale for paddy on private lands have been reported upon in the previous number of this Journal. The same gentleman holds lands near Bangalore also and these have been in the possession of the same family for over a century now. The tenants also have been living there for generations, cultivating dry crops on their own holdings and growing sugarcane and paddy on wet lands for the proprietor on the " Varam " or share system.

Owing to uncertainty of water supply for the growing of paddy, its cultivation has been given up since 1924 and sugarcane is being rotated with crops like groundnut and gingelly. For a long number of years farmyard manure, town refuse and a certain amount of *honge* (*Pongamia glabra*) and castor cakes were the only manures used for growing cane and the yields of jaggory used to vary between 150 to 250 maunds of 28 lbs. each per acre.

Having tried sulphate of ammonia for a couple of seasons as a stimulating manure applied just before tillering, the proprietor as well as his tenants were so satisfied with the results obtained that they were easily induced to try superphosphate as well at the time of planting cane. This too having given them satisfaction arrangements were made in 1925–26 for the trial of sulphate of ammonia and super-

phosphate on a fairly large scale on an area of nearly 10 acres in extent. At the same time, some improvements in the methods of cultivation were also introduced such as wider planting and better drainage.

During 1925–26, the land was parcelled out among 33 tenants, the area given to each tenant varying from 550 to 2,200 sq. yds. At the time of planting cane, superphosphate was applied in the furrows at the rate of 350 lbs. to the acre and 6 to 8 weeks after planting, sulphate of ammonia was applied at 250 lbs. to the acre. When the crop was about 3 months old, cattle manure and groundnut oil-cake at the rate of 1 ton per acre were put in and earthed up.

The variety of cane planted was the local striped with an admixture of white cane. The crop matured normally in 12 months and milling operations were commenced.

The detailed yields of jaggory obtained from various plots are given in Table I. The variation in yield may partly be due to variation in fertility and partly to differences in cultivation, weeding, irrigation, etc., by the various tenants.

The total quantity of jaggory sent for sale was 3,329 maunds. In addition, 301 maunds were paid in kind to workmen at the time of milling. Hence the total yield was 3,630 maunds. There were 1,674 boilings and 32 gallons or 320 lbs. of juice were boiled at each charge. Hence each panful of juice gave an average yield of 2.16 maunds of jaggory.

The yields in former years without the use of artificial manures on the same plot of land used to vary between 150 to 250 maunds of jaggory per acre whereas in 1925-26 with the use of artificial manures as described above, the yields have varied between 250 and 420 maunds to the acre, giving an average yield of over 370 maunds per acre.

Milling in former years was being done by bullock mills but in 1925–26 it was done by a three-roller power mill. Better milling has also contributed to increase in yield which, from previous experiments elsewhere, may be put down at 50 maunds per acre. Deducting this from the average yield of 370 maunds to the acre the average yield due to manuring comes to about 320 maunds an acre. The average yield in previous years according to statements of the proprietor and his tenants did not exceed 200 maunds to the acre. These figures

distinctly show the advantages of using artificial manures for sugarcane.

The use of superphosphate made cane growth possible even on patches of alkali land. Moreover, it altered the quality of jaggory also by giving the particles good crystalline appearance.

The same trials were repeated on another block of land in 1926-27 by the same parties and the detailed results are given in Table II. This crop suffered a little on account of scarcity of water. Still the average yield came up to 318 maunds per acre and yields from different plots varied between 158 and 418 maunds to the acre.

TABLE I.

Results of Sugarcane Manuring at Kyalasanahalli, 1925—26.

Plot No.	Area of plot Sq. yds.	Jaggory per plot in mds.	Jaggory per acre in mds.	Plot No.	Area of plot Sq. yds.	Jaggory per plot in mds.	Jaggory per acre in mds.
1	2,200	132	290	18	1,100	78	343
2	2,200	114	250	19	1,100	84	369
3	2,200	172	378	20	1,100	69	303
4	2,200	167	367	21	1,100	78	343
5	2,200	192	422	22	2,200	117	368
6	550	36	317	23	1,100	74	325
7	550	44	387	24	1,100	78	343
8	1,100	84	378	25	1,100	96	422
9	2,200	170	374	26	1,100	86	378
10	1,100	88	387	27	1,100	81	356
11	2,200	170	374	28	550	33	290
12	1,100	91	400	29	550	37	325
13	1,100	84	369	30	550	37	325
14	2,200	168	369	31	1,100	68	299
15	2,200	159	350	32	1,100	58	255
16	1,650	108	317	33	2,200	108	237
17	2,200	166	365	..	..	..	..

Average per acre—371 maunds.

Dose of manure per acre :

Super Phosphate	3 cwts.
Ammonium Sulphate	250 lbs.
Groundnut cake	1 ton.
Cattle manure	10 to 15 cart-loads.
Variety of cane	Local striped and Rastali.
Nature of soil	Clay loam.

TABLE II.

Results of Sugarcane Manuring at Kyalasanahalli, 1926—27.

Plot No.	Area of plot Sq. yds.	Jaggory per plot in mds.	Jaggory per acre in mds.	Plot No.	Area of plot Sq. yds.	Jaggory per plot in mds.	Jaggory per acre in mds.
1	1,100	59	260	22	1,100	86	378
2	550	29	255	23	550	41	361
3	550	36	317	24	1,100	79	348
4	2,200	140	308	25	1,100	61	268
5	1,100	81	356	26	1,100	90	396
6	1,100	81	356	27	1,100	70	308
7	2,200	178	392	28	1,100	65	286
8	1,100	95	418	29	550	25	220
9	1,650	137	402	30	550	32	282
10	1,650	131	384	31	2,200	135	297
11	3,300	241	353	32	2,200	151	332
12	1,100	76	334	33	1,100	63	277
13	1,100	86	378	34	1,100	59	260
14	1,100	74	326	35	1,100	56	246
15	550	38	334	36	1,100	54	237
16	550	25	220	37	1,100	43	189
17	2,200	162	356	38	1,100	49	216
18	2,200	164	361	39	1,100	41	181
19	2,200	178	392	40	1,100	36	158
20	1,100	94	414	41	1,100	38	167
21	1,100	76	334	42	550	20	176

Average per acre—318 maunds.

Dose of manure per acre :

Super	3 cwts.
Ammonium Sulphate	250 lbs.
Groundnut cake	1 ton.
Cattle manure	10 to 15 cart-loads.
Variety of cane	Local striped and Rastali.
Nature of soil	Clay loam.

Mysore Agricultural and Experimental Union.

Dr. Coleman's Presidential Speech at the Tenth Annual Meeting, 1928.

Members of the Agricultural and Experimental Union and Gentlemen,—

The Secretary's report, I think, can be taken as read as you have already copies of the report in your hands. Considering the abbreviated nature of that report and its rather depressing character I think you will agree with me that a discussion of the work done by

the Union will not serve any useful purpose. It remains, therefore, for me to make my opinion more clear.

In the first place, it is not usual to hold the meeting of the Agricultural and Experimental Union at this time of the year. It used to be the custom any way to hold the meeting especially after the harvest season when people had no anxieties as regards what is going to happen from the agricultural standpoint or perhaps knew the worst or the best for the year. The holding of the meeting in the spring time has never been successful. In fact we held one meeting some years ago in the spring with the result that only a small number of non-official members attended. The Managing Committee think that the affairs of this Union are not very flourishing and prosperous and that we should take stock of the position and decide just what can be done to bring about a return to the interest that used to be taken in the previous years by the members of this Union. We realize, perhaps the Managing Committee realized, that this is an extremely bad time of the year to hold the meeting. I have been informed by an Agricultural Inspector to-day that no less than 12 members of this Union who were expected to attend this time from one particular district have been detained on account of marriages in their houses and some other members also have stayed away for the same reason.

Now I should like to remind the gentlemen here the purpose for which this Union has been organized. We have in this State a large number of organizations which are concerned more or less directly with investigations connected with the development of the State's main industry. We have the Agricultural Department and the related Departments. Those Departments have just now gathered together to take stock of the work that has been done during the past year or so and make plans for the work of the coming year. In addition to that, we have all over the State, the District Conferences. One of the most important functions of the District Conferences is the discussion of agricultural work. In addition to this we have the Economic Conference with an Agricultural Board and its Sub-Committees, which concern themselves very largely with the consideration of the various phases of agricultural development. I do not know whether we have still Agricultural Associations in the State. Probably there are some still existing more or less in a moribund condition.

Gentlemen, it seems to me obvious that unless this Union can do some special job of work, can perform some special function which is not being performed by the Agricultural and allied Departments and by the District and Economic Conferences or the Agricultural Board and its Sub-Committees, unless this Union can perform some organic function, there is really no justification for its existence. What is the unique feature of this Union? The unique feature was the undertaking on the part of the members to carry out co-operatively with the Agricultural and allied Departments a certain definite work so as to enlarge the field of activity of the Department, so as to furnish to the Agricultural Department much exact information as regards the particular improvements which the Department itself feels might be introduced into Mysore Agriculture.

Now, gentlemen, the Mysore Agricultural and Experimental Union has, I believe, done very useful work in this connection and obtained a reputation in the State. What that reputation is it is not for me to say. But I should like to point out to you that both among officials and non-officials, this Union has a definite status and reputation which would be a thousand pities not to maintain. Government have recognized the usefulness of this Union in that they have been subsidising it with a definite amount of money every year. This recognition indicates that Government consider that the Union is doing or can perform particular unique functions in the State. In addition, Government have appointed one of our members as a member of the Economic Conference to represent this Union. I may refer particularly to one fact that at the recent meeting of the Legislative Council when a supplementary demand was placed before that Council to provide a subvention for this year to the Agricultural and Experimental Union I feared that I would have difficulty in persuading the non-official members to support the grant as a cut motion had been tabled in connection with it. I was surprised to find that the particular gentleman who raised the question did so not because he objected to the grant but because he wanted to ascertain why a grant had not been included in the budget of the year when it was originally passed. Now, gentlemen, that indicates that we have a reputation here in the State which is decidedly high.

When we come to the consideration of the reputation outside the State, any such reputation must come to us by means of our

Journal. In the past our Journal has had a reputation for its sound and interesting information. It was almost second to none in India and found a wide exchange with Agricultural Journals of repute all over the world.

Now, gentlemen, I want to ask you to consider as to whether the Experimental Union during the past few years has been performing the functions for which it was organized. You have before you the report of the Experimental Union and we are informed that "during the year 1927, 18 members applied for material for experimental work. Seeds and manure not having been supplied no experiments were conducted. Out of 20 members who had agreed to conduct trials in 1926 and received material, not one has reported results yet. It is not even known whether these members conducted any of the trials at all." That is not a very cheerful state of affairs. It seems to me obvious from the paragraph that in the first instance the Agricultural Department itself has been failing in its duty. If 18 members applied for material and no material was supplied then it is a serious charge against the Agricultural Department. On the other hand, if 20 members in the previous year who were supposed to have conducted trials did not give any reports on the trials, those members also have failed in their duty. Now, gentlemen, I would suggest to you that unless a change can be made, unless we can get back to something of the conditions that existed, say 5 years ago, to be perfectly safe, we should wind up our operations and tell Government that we do not want their subvention and our representation. I might say too that in addition to the particular evidence of reputation, we have had actually representation from the local bodies, branch bodies, seeking, craving, demanding affiliation and close organic connection. I do not know if you would graft a living branch to a dead or dying tree. That would be rather absurd. Do these people in the Districts know the actual state of affairs ? They are under the impression that our organization is flourishing, growing and expanding. If we cannot bring about a change in the state of affairs, we ought to tell them quite frankly that the last thing that they should seek to do is to affiliate with us.

Gentlemen, we have definite subjects to discuss. The number of non-official members attending this meeting is extremely small. I trust that every single non-official coming here has come with the

definite intention of bringing back to it something of the old spirit which belonged to this association at the beginning. I still have hopes that that spirit will come back to us. This meeting to-day is just a preliminary meeting. When the question of election comes it is up to you to decide whether the question of election of officers should not be postponed to some date when we have a more representative body of agriculturists here.

One last word. It has been suggested by members, official and non-official, that the reason for the change in the Agricultural and Experimental Union during the last so many years has been the absence of one man. I do not agree with that idea. I do not believe that any organization in Mysore or any other part of the country can live to any very large extent on the work or the personality of one man and if it attempted to do so it will certainly fail. I speak with a certain amount of diffidence on this subject. I would impress on the members of this Union, old and new, that as the time goes on it will become increasingly important that non-official members of this Union should take more and more interest in the work and as for that one man I may say that there could be no more tragic thing happening than the feeling that his years have been wasted and that important work should cease or fall into decay simply because of his absence. I would not have come back to Mysore if I had felt that. I believe we have among official and non-official members sufficiently able men for the work ahead. But leadership has to be developed. You may remember that some years ago I made a serious attempt towards the appointment of a non-official President to the Union. I have a very strong feeling that this Union will not stand on a sound basis until it has a non-official President with personality, experience and sufficient time to devote to its development. I am sure that unless that is done, this Union will never occupy the position in the State that it ought to occupy. We must try to find men who are prepared to take up the work of conducting the operations of this Union.

NOTES AND COMMENTS.

Agricultural Progress in Mysore.

In his Presidential Address to the Agricultural Section of the Bangalore District Conference on the 6th July 1928, Dr. Leslie C. Coleman, Director of Agriculture in Mysore, referred at some length to "three striking evidences of agricultural progress in the district, *viz.*, (1) the increase in the sale and use of improved implements, more especially ploughs ; (2) the growth in the use of commercial manures ; and (3) the greatly increased interest of the people in general in subjects related to agricultural improvements." Having given figures to show the progress that had been made, Dr. Coleman proceeded to discuss the question as to whether the Mysore agriculturists' condition is improving or not. Here is Dr. Coleman's answer :—

"These figures are, I think, significant for two reasons. In the first place they indicate clearly that the demonstration work of the Department which has been going on now for about fourteen years is bearing valuable fruits. In the second place they indicate, I believe, that a steadily increasing number of our ryots are able and willing to invest appreciable sums of money on the improvement of their cultivation. I should like to make my views perfectly clear on this point. During the recent sitting of the Legislative Council I expressed the opinion that Mysore agriculturists in general are in a better condition to-day than they were twenty years ago when I first came to the Mysore State. This has been taken by some to mean that I believe the agriculturists' condition to be a good one. This is an entirely distorted representation of my position. I realize, I believe as fully as any man in this State, that the Mysore ryots' condition is anything but satisfactory. I also support entirely the views expressed by the Second Member of Council that the Mysore ryot is to-day paying taxes which are, relative to his financial ability, higher than those paid by any other class of citizens and that he is receiving in return in the way of services from the various departments of the State much less than are our citizens who dwell in towns. To a greater or less

degree this is the position of agriculturists all over the world. These undoubted facts should, however, not make us blind to the fact that our agricultural conditions are improving and are not getting worse. If something were not being accomplished in the way of improving the conditions and the position of our agricultural population, what would be the use of spending further money on our Co-operative Department and our Agricultural Department to name two departments actively engaged in work to that end ? If after twenty years' strenuous work, I thought, with the pessimists, that agricultural conditions in this State were deteriorating, I would strongly urge upon Government the advisability of closing down the agricultural and its related departments, disbanding the staffs and utilizing the money now being spent on them for some more useful purpose."

Fodder Supply and Cattle Improvement.

This was another of the subjects which Dr. Coleman discussed on the occasion referred to. Taking note of the increased attention that is being given to the development of fodder supply, Dr. Coleman proceeded :—

" The interest which is being taken by the District Board and by the leading agriculturists in the District in questions of growing fodder crops and of making ensilage from this fodder is, I consider, a very promising sign. However I must impress upon you the fact that this work has strictly limited possibilities unless at the same time measures are taken to improve our live-stock. We cannot hope for any greater extension in the growth of fodder crops as long as the majority of our cattle are of such poor quality and of such small money value as they are at present. A very large number of our animals cannot possibly give, through better feeding, returns to their owners which will pay for the cost of the feed which will warrant those owners laying aside a part of their land for the growing of fodder crops. Before we can persuade our ryots to grow crops for fodder we must be able to show them that they won't lose money by doing so and I should like to see the man who could convince Mysore ryots that it is profitable to put fodder grown specially for the purpose down the throats of cattle which cannot possibly be sold for over Rs. 50 a head when full grown.

"Two main obstacles at present stand in the way of cattle improvement in this State. In the first place we have the terrible epidemic

diseases which are capable of sweeping off more than half the cattle of a village and which are just as likely to attack valuable as worthless animals. Until we are able to give a fairly high degree of protection from these diseases we cannot expect more than a small proportion of our ryots to breed and keep valuable live-stock—the risk is too great. Practically all the energies of the Civil Veterinary Department and the recently created Serum Institute are at present being spent on an attempt to bring under control the most serious of our cattle disease—Rinderpest, and owing to the introduction of the Serum Simultaneous Method of inoculation for which we have to thank our able and energetic Superintendent, Major Simpson, I have strong hopes that within another two or three years we shall be able to give just that kind of protection provided we can obtain, at the same time, the co-operation of local bodies in enforcing measures to prevent the movement of animals from infected areas.

"The next obstacle is the lack of good breeding bulls to grade up our live-stock and so to give us animals which it may pay the ryots to feed properly. In this regard I regret to say we are in no better position than we were five years ago. The real function of the Amrutmahal Department should be to supply good breeding bulls in large numbers. I personally have very little hope that it will be able to perform this function properly on its present basis. What we need in Mysore is a large breeding organization on the lines of the Hissar Farm in the Punjab where I understand they are now turning out 700 bulls per annum for the benefit of the Punjab ryots. We have the foundation stock and the land suitable for this purpose and in fact a scheme for the starting of such a farm was prepared about five years ago. What we need in addition is a trained staff and money to start the work. I would not for a moment suggest a cessation of efforts towards an improvement of our fodder conditions but I should like you to view this question in its true perspective and to realize that our efforts in this direction will not succeed unless we at the same time take measures to control cattle diseases and to grade up our live-stock."

* * * * *

Agricultural Education in Mysore.

Dr. Coleman's speech on the occasion of the distribution of Diplomas to the successful candidates of the Mysore Agricultural

School on the 26th May 1928, was one of more than usual interest. For, therein, he not only traced the history of Agricultural Education in the State from its humble beginnings in 1913 but referred also to the attempt that is being made to settle the trained men on the land in response to the demand that has arisen in the State. The address was reported in the daily papers at the time but in view of the importance of the subject and Dr. Coleman's considered opinion on it, we have reproduced it here :—

"The history of Agricultural Education in Mysore has been one of slow and cautious development. When the Hebbal Agricultural School, the first institution in the State for the purpose of agricultural training, was founded now 14 years ago the initial expenditure was kept down to the irreducible minimum. The school itself was housed in what had been the farm cattle stalls which were at comparatively small expense remodelled for the purpose. The school staff has consisted from the first of men who have had, almost without exception, in addition, other important duties to perform in connection with the investigation work of the Agricultural Department.

It is usual in the case of agricultural schools and colleges in India to provide comparatively large areas of land solely for the practical training of the students. Established as our school was on a comparatively small farm where carefully planned and scientifically controlled experiments have occupied the most of the land, practical instruction has suffered.

Notwithstanding these real disabilities our school has done very useful work. When I tell you that almost the whole of our District staff on whom directly falls most of the work of bringing in results of our experiments home to the agriculturists of the State, I think you will agree with this statement. I believe there are few other parts of India where the agricultural department is so closely and beneficently in touch with agriculturists as in Mysore and this would not be possible if we had not an efficient and conscientious district staff. But in addition to this, quite considerable numbers of our past students are engaged either in the cultivation of their own land or in other employ inside or outside the State where their agricultural training is being directly used. There are, I believe, very few of them who have sought walks of life where their training is of little, if any, use to them.

There are wide differences of opinion as to the purposes which a higher agricultural school or college should serve. Some see in it an institution which should be used almost exclusively for training men to occupy Government posts, in the Agricultural, Educational, Revenue and other Departments of Government, where such training can be advantageously utilized. Others prefer to look upon such an institution as a centre from which will go out young men who by cultivating their own lands will quicken the agricultural life of the country. It seems altogether probable that an institution cannot give in the same course training equally calculated to fulfil these two ideals. However as with so many institutions in this country financial considerations have compelled us to abandon the best and cling to the possible. It seems likely that our vernacular agricultural schools, which will probably grow in numbers rather rapidly in the near future, will fill much of the need for training men to go back to the and but I cannot help but feel that these institutions will not fill the whole need. I believe, as time goes on, there will be no inconsiderable number of our educated young men who will, through choice or force of circumstances, take to agriculture as a means of livelihood. If, as I hope will be the case, a scheme for agricultural colonization can be developed in this State, the demand for agricultural education of a higher and broader character than can be supplied by our vernacular schools is likely to grow and we shall have to make provision to meet that demand.

To the young men who are now leaving our school, let me say, you have no reason to be ashamed of the education you have obtained. It may not be looked upon by people in general as of so high and distinguished a character as that furnished by an arts or science college but it has given you a training which has brought you into close contact with nature and no man can spend three years in such association without benefiting greatly in mind and character. It has moreover forced upon you rather severe physical discipline for which in after, years you will be thankful. I am strongly of opinion that the man who has not known from day to day through physical efforts what it is to be tired almost to the point of exhaustion has missed much of what life has to teach him. For one thing he can never appreciate as he should what the life of our great agricultural population really means. I have often wondered whether the many years

I personally spent in academic halls have done as much for me as have the years I have spent out in the sun and rain wrestling with the forces of nature. It is for you young men to show to the people of Mysore that these years of mental and physical effort have not been wasted. Our best wishes go with you."

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The Eleventh Annual Meeting.

The Eleventh Annual Meeting of the Union will be held on the 21st and 22nd November, 1928, at Bangalore. On the 23rd will be the "Field-Day" at the Hebbal Farm, as usual.

One of the two important subjects which will come up for discussion at the meeting is that of "Cattle Breeding and Disease Control". The subject of Fodder Supply being important from the standpoint of cattle breeding as well as that of disease control, will necessarily receive attention. In fact, it is impossible to discuss the three subjects independently without arguing in a vicious circle. We hope for both an interesting and useful discussion resulting in the formulation of a sound policy on this most important aspect of the State's Agriculture.

The other subject is that of Well Irrigation. This subject was discussed already at a previous meeting (in 1923) which recommended "a small technical agency with suitable mechanical equipment to be attached to the Agricultural Department". The small agency came into being soon after but did not stay long, at least as an adjunct of the Agricultural Department. The area under well irrigation in the State is nearly a lakh of acres, being the third largest area under a single source of irrigation. That there are difficulties in the way of a large scale construction of wells is fully recognized, but in view of the desirability of a large expansion under this form of irrigation, the difficulties will have to be met and overcome. How this might be done and what agency might appropriately be entrusted with the work are matters which the meeting will no doubt discuss. We look forward to a profitable discussion on this subject also.

A special feature of this year's field-day is that a small demonstration, by way of exhibits, of the work of the Department and a small cattle show have been arranged. We promise the members an interesting time all told. [N. V. S.]

SELECTIONS.

Utilization of Agricultural Wastes.

Whether or not you already know what lignin is and what it is for, you are likely to hear and learn more about it within the next few years. Lignin is a constituent of agricultural wastes, such as corncobs, corn stalks and straw, which in the past have almost been entirely wasted. Several years ago the chemists of the United States Department of Agriculture undertook to salvage some of the value of these by-products of the farms, and in the course of time evolved processes for the manufacture of furfural which is now being used for many purposes. The Government discontinued the furfural experiments when commercial interests took over the work.

Lignin makes up from 20 to 30 per cent of the dry material of these wastes. The chemists have succeeded in converting lignin into varnishes, dyestuffs, and various aromatic chemicals that give promise of finding their places in the commercial chemical field. "Lignin," says Dr. Browne, Assistant Chief of Chemistry and Soils, "may be called the greatest of all unutilized agricultural wastes, and it occupies with respect to industrial possibilities, the position held by coal tar a century ago."—*Agricultural Gazette of New South Wales*, Vol. XXXIX, Part 5.

Irrigated Sugar Lands Give Big Yields.

In Natal one of the estates has long given a lead in the experimental work connected with irrigation. We are (writes the *South African Sugar Journal*) preparing an article showing in detail what has been done in this respect, but in the meantime we would just like to give a few facts regarding their irrigation scheme. They are irrigating 3,292 acres of cane with 214,714,000 gallons of water, equal to 2.88 inches of rainfall distributed over the whole year. These are interesting figures, but the results are simply astonishing. For the season 1926-27 they cut cane from 601 irrigated acres, and the increase in the tonnage is sufficient to set any one thinking. The increase due to irrigation amounted to 3,802 tons of cane, as compared with the same area previously cut without irrigation. The figures show an average increase of 19 tons per acre. One of the joint managers states that where a planter is able to give 15 inches of

irrigation in addition to the normal rainfall, he can nearly always be assured of an increase of 22 tons of cane per acre. The concern, known as Natal Estates, to whom we are indebted for these figures, has cut cane grown under irrigation at twelve months old, which gave a crop every two years of 35.5 tons per acre, and if a one year's crop under irrigation is compared with a two years' crop without irrigation, the increase actually works out at 51.3 tons per acre.—*Tropical Life*, March 1928.

How to Prevent Deterioration in Paddy Yields.

By K. Venkataraman, M.A.,

Assistant Paddy Specialist, Aduthurai.

There are three stages at which seed is likely to get contaminated by mixture, and care should be taken at every stage to ensure purity of seed.

1. The stray paddy grains in nursery should be sprouted and uprooted before the seed-bed is made ready for sowing.

2. The field in which seedlings are to be transplanted should similarly be guarded against dormant paddy grains fallen from the previous harvest. These should be sprouted by wetting the fields and destroying the sprouted seedlings effectively by ploughing. The fields should then be got ready for transplanting.

At the time of flowering of the crop, stray plants belonging to varieties other than the general crop should be spotted out and removed. This operation is called 'rogueing', and should be confined to a small area, the harvested grain from which will provide the seed for the next season's sowing.

3. The threshing of seed-paddy should be done under close supervision on clean and well-swept threshing-floor. All stray paddy grains should be kept off. In the successive operations of drying and storing seed-paddy, it is essential to see that the containing receptacles or gunnies are quite free from stray seeds sticking to their sides.—*Rural India*, Vol. II, No. 12.

The Nature of Agricultural Production.

Farming in all countries and at all times is something of a gamble against the seasons. The farmer takes a course which experience has proved to be justified on the average, and he pursues that course with little regard to temporary fluctuations of yield and price. The manufacturer determines his production by the orders and inquiries he receives; he can rapidly reduce output to meet a decline in demand. Temporary

over-production there may be through competition to secure a share in a shrinking market, but in every way the output of the industries is more quickly controlled than that of agriculture can be. Indeed, to a large extent, the output of agriculture cannot be controlled at all. The greater part of the farming of the world is done by peasants or family farmers, who have only one routine for the farm and no alternative occupation. They may vary the cropping a little in accordance with prices, but in the main they must continue on the accustomed paths whatever the prices, because for them the farm is primarily a living than a business. They sell only their surplus, and if it sells badly there is but so much the less to spend upon clothes and the other necessaries they must buy. Bad times affect the production of a peasant community but slowly. Eventually the younger generation declines to carry on so unremunerative a calling, and this sort of decline in the agricultural population becomes dangerous unless it is accompanied by some increase of efficiency on the land that remains in cultivation.—*The Journal of the Ministry of Agriculture*, Vol. XXXV, No. 2.

Organic Manures and Artificial Fertilizers.

A suggestion is made by C. M. Hutchinson (*Agric. Journ. Indi*, XXIII) that artificial fertilizers be mixed with applications of organic manures. It was found that the application of a mixture of 12,000 lbs. of cowdung and 60 lbs. of sulphate of ammonia per acre gave a greater economic return than the application of 16,000 lbs. of cowdung alone. Moreover the more readily available supply of nitrogen in the mixture gave a more rapid return in the crop. The idea is particularly applicable in India where cowdung is the main fertilizer used and, at the same time, the supply is limited. The peasant thus tends to concentrate his supply of manure on his good land rather than attempting to recover his poor land. Assuming that the physical condition of the good land is superior to that of the poor land, there will be greater response to the fertilizer on the former than on the latter. Also, the available nitrogen and not the humus content becomes the determining factor for yield increase on the good land whereas on the poor, the humus content of the soil plays the most important part. As the nitrogen content of cowdung is relatively low, a fairly heavy application is necessary to produce an immediate and appreciable increase in crop on the good land. These lands are therefore treated in excess of their humus requirements.

By raising the nitrogen content of the manure by the addition of sulphate of ammonia, the application of an excess of humic matter to a

good soil can be avoided without affecting the increase in yield. The supply of organic manure can thus be made to cover a wider area.

In poor lands of low humus content, any reduction in the amount of organic matter applied would be a short-sighted policy although additional sulphate of ammonia will probably still give increased yields. In conditions similar to those obtaining in India, however, the practice of such mixing may mean the saving of large areas of comparatively poor land.—*Tropical Agriculture*, Vol. V, No. 8.

The Country's Immediate Needs—Agriculture.

By Sir M. Visvesvaraya.

In this country, agriculture as a profession is distasteful to many at present, because the holdings are small, profits are slender and employment is intermittent. Except during ploughing, sowing and reaping, our farmers in unirrigated tracts have much idle time on their hands. The actual number of days in the year required to cultivate dry crops is probably two months and as the work is not continuous, our cultivators keep up the pretence of farm work throughout the year. Mr. Henry Ford of Automobile fame has stated that he obtains the best yield from his lands by working on them only for 15 days in a year. In America, through the use of machinery, the number of persons employed in agriculture is being reduced though production itself is actually increasing.

The system of agriculture followed in many parts of the country is still of a primitive type. The farmers are too illiterate to understand the value of modern scientific methods and too poor and too unorganized to adopt improved practices. Agriculture needs to be enriched by the use of capital, scientific methods and sound commercial management; in other words agriculture needs to be industrialized.

Engineering and chemistry are the two sciences most concerned with agriculture. The scientific portion of farm work includes soil analysis, selection of seed and fertilizers, destruction of insect pests, animal husbandry, and the use of modern agricultural machinery and tools. Some of our larger agriculturists at least should start the use of ploughing, sowing and harvesting. Every farmer should have some elementary training in mechanical engineering to be able to attend to repairs to his ploughs, pumps and agricultural implements. Every farmer, worth the name in some of the advanced European countries I have seen, owns an oil engine when he has no other source of power supply. Every town and many villages possess a technical school of some sort and every city a

technical college. Agriculture and engineering should go together. At present agriculturists do not know the elements of engineering. and engineers except some of those engaged in irrigation do not know agriculture. In European countries agricultural engineers form a class of experts themselves. The Agricultural Commission has made many excellent suggestions but they are not likely to materialize unless the ground is first cleared by providing liberal agricultural education and banking facilities and by encouraging team work and self-help among the rural population.—*The Mysore Economic Journal*, Vol. 14, Nos. 9 & 10.

The Chemical Composition of some Ceylon Paddies, Rices and Milling Products.

(We extract the following from an article on the subject published in the *Tropical Agriculturist*, Vol. LXX, No. 4, for April 1928.)

Chemical analyses were made of samples of typical Ceylon paddies, rices and milling products, and the changes in chemical composition of the grain as a result of parboiling, pounding and polishing by the Ceylon village method, and machine-milling and polishing, studied.

The following conclusions have been drawn :—

(1) Ceylon paddies are on the whole similar in composition to the paddies of India and other paddy-growing countries. They appear however to be richer in proteins and minerals than the latter. Dry land or hill paddy, as reported by previous workers, is found to be richer in organic constituents but poorer in minerals than irrigated paddies. The pure-line paddies analysed were richer in nutritive constituents than the mixed varieties.

(2) The same remarks as above apply to the hand-husked rices. The high protein content of Ceylon hand-husked rices as compared with those of other countries is very probably due to the method of husking. Phosphoric acid is the chief inorganic constituent of the samples analysed and amounts to just over half the ash content.

(3) The pounding and polishing of rices result in a marked decrease in their fat, phosphoric acid, fibre and to a smaller extent protein contents. It would therefore appear that the "skin" and surface or "aleurone" layer of the rice grain contain the more valuable nutritive constituents of the grain. Machine-polishing of rices results in greater losses of fat and phosphoric acid than by the village method of pounding.

(4) Parboiling affects inappreciably the chemical composition of rices except for the fat content which falls slightly.

(5) Bran or the residue after the second pounding of paddies contains large proportions of the fat, protein and phosphoric acid of the latter.

More than half the phosphoric acid, three-fourths the fat and one-fifth the protein of Murungan paddy were found in the bran. Higher percentages of fat and ash are found in the bran of parboiled than of raw rices.

(6) The chemical composition of polished rice is nearest to that of wheat flour. Rice has much less protein and fat and considerably more carbohydrate than other foodstuffs. A diet of rice and legumes is a well-balanced one.

(7) The samples of husk analysed were not typical, but the analytical data are similar to those obtained by Wol. The ash content is very high.

Vitamins and Vitality.

By Professor J. Arthur Thomson.

Their Tremendous Importance in a Health Diet.

The little things of this world often count far more than the large. The invisible microbe kills the giant; the minute drops of hormone regulate the health of the body; tiny quantities of vitamin make all the difference between food on which we thrive and food on which we become diseased. Indeed, it is characteristic of vitamins that they are present in very minute quantities in the food, and that is why they are technically called " accessory food-factors ". A very little goes a long way.

When people or animals feed exclusively on polished rice, with the delicate cortex taken off, instead of on whole rice, the disease of beri-beri, or something allied, sets in. The inference that has commended itself to most physiologists is that a chemical entity of some sort is lost with the removal of the outer zone of the rice grain.

Nobody has Seen a Vitamin.

This inference is confirmed by the fact that the disease can be checked and health restored by replacing what was removed, or by adding to the polished rice diet a small quantity of some other kind of food which is therefore believed to contain the missing vitamin. The various kinds of vitamins have been much studied during the last ten years, but we do not yet know their chemical nature or how they work. No vitamin has yet been obtained in a state of indubitable purity.

How did our forefathers do without vitamins? The obvious fact is that they did not, for vitamins are present in the natural mixed food that sensible people usually eat if they get a chance. A deficiency arises when the diet is too monotonous, or too artificial, or when the food is much broken up and only part of it is used. " The most striking evidence for

the evil effects of the artificial treatment of the food first came from rice-eating districts of the East when they had been invaded by milling machinery from the West."

Vitamins and Scurvy.

When our sailor forefathers went a long voyage with salt beef as a staple food they did not get on without vitamins, for they took scurvy. We have changed all that and scurvy has gone by the board. Apart from the shortening of the voyages from port to port and the increased possibilities of carrying varied food, the deficiency disease of scurvy can be kept away by serving out lime juice.

In old days no one understood scurvy, but it is curious that sailors should have chewed "scurvy grass" when they reached a shore. Some of the vagaries of appetite among animals and children may be unconscious groping after vitamins, which are formed primarily and mainly in the tissues of green plants.

The precise role of the indispensable accessory food-factors is still uncertain but there are two possibilities. It is possible that vitamins are essential constituents of the living matter, just as proteins are, and that they cannot be built up in the animal body but have to be borrowed, as it were, from plants or from the milk of vegetarian animals, and so on.

All Flesh in Grass.

Similarly, on land, all flesh is, in the long run, grass. The point is that vitamins may be obtained from animals which have not built up vitamins themselves, but have derived them at first or second hand from plants. Another view is that vitamins owe their potency to some dynamic influence that they exert on the every-day metabolism, or chemical routine of the body. They are not ferments, but their virtue may be "catalytic"; that is to say, they may accelerate associated chemical reactions.

A fine account of vitamins, edited by Professor Harden, will be found in the second edition of a report by the Medical Research Council (His Majesty's Stationery Office, 4*s.* 6*d.*), and strongly to be recommended is a luminous book, "Vitamins and the Choice of Food", by Professor and Mrs. Plimmer (Longmans, 7*s.* 6*d.*). It may be noted that vitamins were practically discovered twenty years ago by Professor Sir Frederick Gowland Hopkins, the distinguished bio-chemist of Cambridge.

Different Kinds of Vitamins.

(*a*) Fat-soluble vitamin A, first detected in butter and yolk of egg, is abundant in cod-liver oil and in many vegetable oils. Its primary source is in green leaves and seaweeds. It seems to promote growth and to have something to do with the utilization of fat in the body.

(*b*) Water-soluble vitamin B is found in cereals, pulses, eggs, yeast (marmite), lemons. It counteracts beri-beri diseases and works against certain forms of nervous degeneration. It is called anti-neuratic.

(*c*) Vitamin C, which works against scurvy, is abundant in green vegetable, fresh fruits like lemons, and especially sprouting seeds. It is called anti-scorbutic.

(*d*) Allied to Fat-soluble vitamin A is another with similar physical properties and distribution, which works against rickets. It is called anti-rachitic. But its work in promoting the proper calcification of bone has to be backed up by sunlight.

Four Japanese bio-chemists claim to have isolated vitamin D for which they propose the name Biosterin, or Life-oil. It is a reddish yellow oil so potent that an ounce will last a man all his life. But it can kill as well as cure except in Nature's dilutions.

(*e*) Of great interest, but clouded in uncertainty, is a new fat-soluble vitamin E abundant in ether extract of wheat embryos, and in dried leaves of lettuce. It occurs unhurt in dried leaves of peas, in seeds like cotton and Indian corn, in some fruits like bananas, in egg yolk and many animal tissues. Its special interest is that it seems necessary for the successful development and normal birth of offspring. It might be called the vitamin of reproduction.—*Journal of Animal Husbandry and Dairying in India*, Vol. II, Part 2.

Field Experiments with Fertilizers.

By H. H. Cousins,

Director of Agriculture, Jamaica.

Since 1901 co-operative field experiments with fertilizers have been carried on on sugar estates in Jamaica under the ægis of the Department of Agriculture; and Mr. Cousins now offers a concise summary of the results of 25 years' work in this direction.

The original scheme of field experiments as carried out in Jamaica was designed by Mr. Cousins to suit the special circumstances of the sugar industry in Jamaica, which is that of a large number of relatively small areas of sugarcane each growing in soils and with rainfall and climatic conditions showing a wide variation. Elaborate experiments with a very large number of plots in order to test out the finer variables in profitable manuring were therefore not suitable for conditions in Jamaica. A series of 10 to 14 different plots with at least one and generally two "no

manure" plots were designed for the experiments. A crushing in the estate mill of an average lot of the experimental canes with a juice analysis enabled the tonnage results to be calculated into juice and available sugar under the actual estate conditions. Soil analysis, including the determination of available potash and phosphoric acid and a physical analysis of soil and sub-soil, were also generally carried out for each series. As a result of experiments the number of "no manure" plots was increased in some of the later experiments. Large plots were not found to be more reliable than the standard plots as used in these experiments, *viz.*, 1-10 acre or 1 square chain.

The experiments cover a period during which the price of sugar has varied from £6 per ton to £100 per ton (in 1920). From 1900 up to the outbreak of the war in 1914 the history of the sugar industry in Jamaica was discouraging and the exports of sugar had fallen to about 15,000 tons, so that sugar at that time ranked rather as a "minor product" than as a leading staple in the Colony's trade. After the war, encouragement was given by Imperial Preference and capital was invested in sugar so as to raise the export from Jamaica to a standard of 50,000 tons in 1927.

In many cases the limiting factor of sugar production in Jamaica is water. Where irrigation is not available the rainfall exercises a paramount influence on the problem of manuring. Under conditions of inadequate rainfall the expenditure of money on fertilizers by an estate thus situated is a gamble against the weather. Under very bad conditions, fertilizers have actually reduced the yield, due to the dying out of the soft young growth of canes as a result of acute drought at a later stage of development. Under such conditions, mulching is more valuable than manuring with artificials. Where conditions of rainfall are reasonably steady, although not sufficient for maximum development of the canes, the use of fertilizers has been found profitable and planters now use them regularly.

The chief results to be gathered from these field experiments are the following :—

1. *Value of Lime.*—Half a ton of slaked lime per acre every third year has given profitable increases of cane on many soils where cheap power is available, the application of pulverized limestone has been found productive of increased tonnage, while many estates have traditions extending over a century of the benefits accruing from an occasional application of "marl".

2. *Nitrogen the most Effective Fertilizer.*—Where the conditions of growth enabled the crop to develop, the application of 100 to 300 lbs.

per acre of nitrate of soda or sulphate of ammonia has been generally profitable. On some soils no other fertilizers appear to give profitable returns. In some instances, nitrate of soda has produced a marked result while sulphate of ammonia failed to give a return. This is associated with the lack of lime in the soil and the acid resulting from the use of the sulphate of ammonia. On the majority of the soils, however, sulphate of ammonia appears to be the most successful form of nitrogen to be applied to sugarcanes in Jamaica. "Nitrolim" and "Ammophos" are two of the newer fertilizers containing nitrogen that are still under trial. The former is the cheapest form of combined nitrogen now obtainable in Jamaica, while the latter possesses the advantages of being a soluble, neutral phosphate as well as a source of nitrogen. Experiments to test these fertilizers against the other standard forms of nitrogen are now under way.

3. *Phosphates rarely profitable.*—In the early experiments one used a "mixed phosphate" prepared by blending acid superphosphate with neutral steamed bone flour. Basic slag frequently gave results when the other phosphates failed to do so. Further experiments revealed the fact that the good results for basic slag were apparently due to its content of lime. In most cases in Jamaica phosphates are not profitable as applied to sugarcane. The vendors of proprietary manures generally use a proportion of superphosphate in their special cane manures, based on English practice for the fertilization of crops in the United Kingdom. The Jamaica experiments showed that these proprietary manures were frequently inferior to and more costly than a suitable mixture of, say, sulphate of ammonia 2 parts, sulphate of potash 1 part, which has been generally adopted by planters as a standard fertilizer for sugarcane in Jamaica.

4. *Potash frequently profitable.*—In some cases potash is absolutely necessary in a cane manure for certain soils in Jamaica. There are estates where potash gives no return, but speaking generally, ½ to 1 cwt. of sulphate of potash (50 per cent) per acre is a sound addition to a nitrogenous manure for canes.

5. Tillage and drainage are of more importance as affecting the crops than the application of fertilizers. No expenditure on fertilization can make up for a defective cultivation or rectify unhealthy soil conditions brought about by lack of drainage.

The use of steam ploughs and resort to deep tillage has brought about some remarkable yields of cane, particularly in the heavier soils in Vere and St. Catherine.—*The International Sugar Journal*, Vol. XXX, No. 355.

Orchard Drainage.

By H. W. Davey,

Chief Orchard Supervisor.

Very many people are under the impression that because of our hot summers there is little or no need for sub-drainage in the orchard. This is quite an erroneous idea. Sub-drainage allows greater root penetration than can occur on land not so drained, and the lowering of the water table permits the roots of trees to go much deeper into the soil, thus reaching moisture conditions during the dry summer months.

The soil is in ideal condition, so far as water content is concerned, when it contains just about half the amount of moisture it is capable of holding. For example, a heavy clay soil can absorb water to the extent of about 40 per cent, that is, 100 lbs. of such clay fully saturated with moisture will contain about 40 lbs. of water. The best condition for trees is when the soil contains much less than this amount, say, from about 15 to 18 per cent. If land carries a heavy percentage of water, the air between the particles of soil is forced out by the water taking its place with the result that the soil becomes water-logged.

A lack of oxygen in the soil then prevents the chemical action taking place, which is vital to the health of the trees, the soil having become sour and inert.

From a physical aspect, soil may be divided into three parts. First, we have the soil proper consisting of the grains of different sizes and arranged in different ways, and consisting of insoluble soil minerals, or else minerals not readily capable of solution.

Secondly, the moisture that surrounds the soil grains, and it is in this moisture that is contained a varying amount of the soluble soil constituents on which the roots of trees depend for their nourishment.

The third part is the atmosphere which differs little from the air above the surface excepting that its humidity is greater.

It can, therefore, be readily understood that, when soils reach a condition of complete saturation, all the air has been forced out of them, and its place taken by water. It is to prevent this water-logging of the soil with its harmful effects that sub-draining the orchard is carried out. It is therefore of the greatest importance that all excess water should be removed from the land as quickly as possible, and this is best achieved by means of tile-draining.

Water can often be prevented from entering land or can, at any rate, be quickly removed by means of surface drains; these are particularly useful for intercepting and carrying off water coming from higher levels.

Many trees in the irrigation areas are suffering from excessive water. This trouble could be remedied by sub-drainage. In numerous instances, however, water-logging of the soil takes place not from excessive applications of water by the owner but rather it is due to bad grading of the land, with the result that depressions have been left, and in these water collects in much greater quantities than is good for the health of the trees.

Another frequent cause of excessive moisture in some of the northern districts is that the water tables of roads adjacent to orchards are too high, and consequently in wet weather the roads become more or less flooded, and instead of the channels carrying off surplus water from them it may happen that the water from the roads drains into the orchard with resultant damage to the trees.

If drain pipes are sunk into the ground as observation boxes, the height of the water table in the orchard can easily be ascertained, and this knowledge will prove to be very useful, and sometimes surprising.

To drain an orchard, it is generally agreed that a drain should be placed between every second row of trees. Thus, the first drain should be put down between the first and second rows, the second drain between the third and fourth rows and so on until the whole of the orchard has been finished. Draining tiles of from 2 to 3 inches diameter and 12 inches long are the sizes most commonly used. When practicable, pipe drains should discharge into an open ditch or else into a main drain of 4 inch pipes.

In cases where there is not a good get-away for the water, either by a natural fall of the land or else by draining into an underground drift, the water may be drained into a well from which it can be lifted by means of a windmill.

Wooden drains are not recommended under any circumstances.

The best time to carry out drainage operations is in late autumn as the land is then usually in good condition for digging the drains. It is important that the drains should always follow the fall of the land and never across the fall.

After levels have been taken and the lowest point ascertained, digging the trenches should be commenced. Special ditching tools should be purchased, for they will greatly facilitate the work.

The trenches should be quite narrow at the bottom, widening as they approach the surface of the ground.

In heavy clay soils drains should not be placed any deeper than 2′-6″ for if draining tiles be placed too deep in such ground, they become almost impervious to water from below, and it must be remembered that the water rises into the tiles from beneath them and does not sink down into

them. It is after the ground becomes saturated that the water rises into the pipes at the points and is then carried off.

After the trench has been dug for the reception of draining tiles, and the bottom carefully graded as to its fall, all crumbs of clay should be carefully removed from the bottom of the trench by any implement specially made for that purpose. The pipes are then laid along the bottom and butted up to each other as closely as possible, each tile being placed well into the clay. Care should be taken not to stand on the pipes after they have been placed in position at the bottom of the trench; this might displace some of them, especially if there be any soft patches of soil beneath them. The pipes must be laid in position straight and even; if the joints are not close together they may become silted up; this will encourage the roots of the trees to enter, and sooner or later the drains will become blocked, making it necessary to lift and relay the pipes.

When the pipes are in position, and before the soil is returned, they should be covered with either tarred or brown paper (the former being preferable); this prevents any disturbances of the pipes during the filling in process, and also keeps soil particles from entering at the joints.

Grass sods should on no account be used as a substitute for the paper.

In filling the trenches, about 6″ of the clay sub-soil should be returned first; this should be firmly trodden down after which the remainder of the soil can be returned as far as possible to its former position in the ground.

Where a job cannot be completed in one day, care should always be taken to protect the upper ends of drains, pending the resumption of work next day. This can be effected by closing the upper end of the drain by means of a bag or similar material so that in the event of heavy rains occurring during the night the soil will not be washed into the tiles.

It is also advisable to protect the outlets of any completed drains with perforated zinc so as to prevent the entry of small animal life.

Difficulties sometimes arise owing to yabbies (the so-called land crabs) working beneath the pipes at the joints during wet seasons and by puddling the clay which is then carried away by the drains. This causes cavities to form beneath the tiles, allowing some of them to drop out of position, and siltation in the pipes follows. In these places where yabbies are numerous, damage by them can be prevented effectually by placing sawn or split palings beneath the tiles when laying the drains.

It is a mistake to deeply trench land that requires sub-draining; this will only aggravate the evil by creating a reservoir for holding the water.

All land does not require draining; some, owing to its formation, drains naturally.

Investigation has shown that the cause of many of the soil troubles in irrigation areas is due either to the sub-surface being water-soaked from seepage, or else to the excessive use of irrigation water which causes the rise of capillary water, the upward movement of which exceeds the downward movement of rain water. Where any of the water, brought up from the depths of the soil contains salts in a soluble condition, these will be deposited in the soil as the water evaporates.

Therefore, when there is a lack of rainfall the salts must be washed out of the ground by means of irrigation, and the water with its soluble salts carried away by means of underground drains. In such of the areas referred to a drift can usually be found by boring into which the drains can be laid. In these cases a silt box must first be put down for drains to discharge into, so as to prevent the drift from becoming choked with silt or mud.

In heavy soils that are compact and impervious, drains should be laid shallow—never deeper than 30 inches.

In light open soils, drains should be placed deeper, say, from 3 to 4 feet, and further apart.

Hydrostatic water, or the water of complete saturation, is the cause of many orchards being unprofitable in Victoria, and unless it be removed by drainage it is impossible for such orchards to become payable propositions.

It is worth noting that land that is very wet during winter is usually very dry in summer. Trees growing on lands of this kind are frequently thought to be suffering from attacks of root borer or armillaria when the whole trouble is entirely due to an excess of water remaining in the soil for too long a period.

By under-draining land, water is prevented from rising for any length of time above a certain level to the detriment of the roots.

The benefits derived from the tile-draining of land are many, the most important of which are as follows :—

1. Increased health of trees owing to better root system.
2. Water is taken down through the soil and not along its surface.
3. Less loss of plant food, such as humus and nitrogen.
4. Drained land is moister in summer and drier in winter.
5. Land can be cultivated earlier in spring and is warmer as evaporation of surface water cools the soil.
6. Water-logged land excludes air, but in drained land the water sinks down and air follows it.

7. The congenial soil for root pasturage is increased to the extent that the water-table is lowered.—*The Journal of the Department of Agriculture*, Victoria, Australia, Vol. XXVI, Part 7.

Cross-Breeding and Grading of Cattle in India.

By K. W. Forman, B.S.A.,

Professor of Dairying and Animal Husbandry,
Allahabad Agricultural Institute.

It has long been an understood fact that cross-breeding as well as in-breeders, when used as a regular practice, is detrimental. Our master breeders used both these methods only as a means to an end of the establishment of our present-day breeds of cattle of the West. The same must be done if we wish to establish a breed of cattle in a short period of time which will be supreme in milk-producing and disease-resisting qualities. In general cross-breeding is defined as the mating of individuals which are not related, but as a rule cross-breeding means the mating of individuals belonging to different breeds or the union of animals belonging to different species.

As in-breeding tends to simplify the germ-plasm and strengthen the powers of transmission, cross-breeding tends to weaken the prepotency and complicate the elemental constitution of the hereditary substance. Crossing has a tendency to break up established characters. It destroys combinations of characters which have long existed in the strains and which under the system of pure breeding have behaved in a manner like unit characters in transmission. Because of this, cross-breeding cannot be carried on indefinitely. It does, however, serve a good purpose in the starting of a new breed. The very fact that crossing disturbs the balance of characters and brings about recombinations in the germ-plasm gives it a peculiar value in causing variations to appear.

The breeder who is working with pure-bred animals which owe their purity of breeding to a long period of careful selection by skilful breeders, cannot hope to cause any great degree of improvement. Pure bred animals are already improved. About all any breeder working with pure bred animals can do is to select out the highly desirable strains from those of lesser value already in the breed. But, as Johanssen has shown, there are very definite limits beyond which the improvement of pure lines cannot go. If Indian breeds could be improved to the high degree of efficiency of the Western breeds in a reasonable length of time then pure line breeding would be well worth while. There may be three or possibly

four indigenous breeds which could be bred to a fairly high degree of milk-producing efficiency in a reasonable length of time and this should certainly be done, but it is very doubtful that any Indian breed will reach the high degree of efficiency of our major dairy breeds of Europe. Marked improvement must come through variation. Crossing is a common cause of variation. Variations which appear as the result of crossing may be desirable or undesirable. Desirable variations may be perpetuated; by in-breeding a new and valuable quality may be secured in this way.

There are two methods that may be followed after the first cross. The first method is the practice of grading after the first generation from two different breeds have been obtained. The continual mating of pure bred bulls to the first generation and to all the generations that follow will gradually develop a type identical to the breed the sires represent.

The second method is the practice of again crossing members of two separate families which are the first generation of two separate breeds. By applying Mendelian principles, which will differentiate the qualities of an animal and will determine their behaviour in transmission, the practical breeder will then carry on breeding methods upon the principles of segregation and dominance which are the foundation-stones in the theory of Mendelian inheritance. Just a start in this second method has been made at the Lucknow Military Dairy and some very hopeful results have been reached so far. In this article, however, we will take up what has been accomplished through the first method at the Lucknow Military Dairy. Colonel Matson, Assistant Controller of the Military Dairies of the Southern Circles, has very kindly allowed me to make use of this information in any way for the advancement of breeding in India.

The first method was the method adopted in America. The Americans benefited by all that Europe built up through scientific breeding. They imported pure bred animals from Europe and mated them with native or unimproved animals. By the continuous use of pure bred sire many high producing animals of different breeds were established. This method unfortunately has proved unsuccessful in India as far as the Ayrshire is concerned. This fact is well recognized by the Military Dairy authorities who have done the most expensive work in cross-breeding in India. The main reason for the failure of the Ayrshire is due to the fact that it has not the characters which will blend with the characters of the Indian breeds and which it has been tried in the making of a progeny which will have constitution as well as good milking qualities in the second and third generations. Just how far this will apply to all the other European breeds is yet to be seen. However, it may be said that the Holstein-Friesian breed has so far surpassed the Ayrshire breed.

The three-fourth Ayrshire is very inferior to the half bred Ayrshire and the seven-eighth Ayrshire is a hopeless animal both from the point of breeding as well as a milk-producer. The three-fourth Friesian has proved to be a superior animal to the half bred Friesian. Just how far the Friesian can be used for grading up purposes is not yet known. The seven-eighth Friesian Hariana breeds are proved to be animals of good constitution and good milkers. Colonel Matson showed me many cases at the Lucknow Military Dairy to substantiate the above statements.

A cow in the Lucknow herd named Carnation has 25/32 European blood, of which 24/32 is Friesian and 1/32 short horn. The remaining 7/32 is Heriana. She has an excellent dairy conformation, a good constitution, and gave 10,000 lbs. milk during her first lactation period at three years of age. Carnation's grand dam, on her dam's side, a one-eighth short-horn-Hariana cow, only gave an average of 4 lbs. of milk per day which goes to show that the pure bred Friesian sires in the third and fourth generations were responsible for these excellent animals. It will not be surprising if Carnation makes a record in milk production for all India at the end of her fourth lactation. It is doubtful if any three-year old cow in her first lactation has done so well up to this time. Carnation's half sister, Gwendolyn, has 25/32 European blood, 16/32 of which is Ayrshire, 8/32 Friesian, and 1/32 short horn. The remaining 7/32 is Hariana. She has a very poor constitution and gives a very small amount of milk. Colonel Matson attributes this to the Ayrshire blood.

A fairer comparison, however, between the Friesian and Ayrshire breeds can be shown where both breeds were crossed to the same Indian breeds and where only two lines of blood were used in both cases. The half bred animals in both cases are always good, although the Friesian half breds invariably gave more milk than the Ayrshire half breeds.

The Friesian-Hariana half breds and grades average 10,000 to 15,000 lbs.

The Ayrshire-Hariana half breds and grades average 3,000—9,000 lbs.

The Friesian-Sahiwal half breds and grades average 8,000—10,000 lbs.

The Ayrshire-Sahiwal half breds and grades average 3,000—9,000 lbs.

The three-fourth and seven-eighth Friesian and Hariana and the seven-eighth Friesian-Sahiwal always proved to be far superior in constitution and in milk production to the $\frac{3}{4}$ and $\frac{7}{8}$ Ayrshire-Hariana and the $\frac{3}{4}$ and $\frac{7}{8}$ Ayrshire-Sahiwal. Janet, a $\frac{3}{4}$ Ayrshire-Hariana grade, gave about 2,900 lbs. of milk in her first lactation, while Abigale, a $\frac{3}{4}$ Friesian-Hariana grade, gave about 4,900 lbs. of milk in her first lactation. Many more instances like the above go to prove conclusively that the Friesian is superior to the Ayrshire in crossing and grading up with the Indian breeds.

The Friesian not only transmits its milking qualities to its offspring but its characters blend rather than conflict with the character of certain Indian breeds, so that the progeny do not slack constitution as in the case of the Ayrshire grades.

Camella, a 15/16 European cow, of which 10/16 is Friesian and 5/16 Ayrshire, leaving only 1/16 country blood, gave a 42 lb. daily average during her first lactation at three years of age. She is a fourth generation cow, and in spite of the fact that the Ayrshire was used as the foundation bull and was used again in the second generation, the Friesian blood was strong enough to produce a cow with a strong constitution and a capacity for milk production. It so happens that the Ayrshire-Country $\frac{3}{4}$ and $\frac{7}{8}$ grades fall off badly in constitution ; and milk production always falls off accordingly. Although according to Galton's Law there is only twice as much Friesian blood as there is Ayrshire in the cow Camella, yet it is quite possible that there may be more Friesian blood represented in her, knowing what we do to-day about the make-up of the germ-plasm. In the Lucknow herd $\frac{7}{8}$ Ayrshire-Country grades having poor constitution were crossed with Friesian bulls and the progeny were quite often good which seems to bear out the point that the Friesian blood in the cow Camella was responsible for her good record. It was Colonel Matson's opinion last November that the Ayrshire was a complete failure as far as using it for breeding purposes in the tropics was concerned.

A very interesting experiment of crossing half-bred cows to country bulls showed that the progeny were poor milkers but when country cows were crossed with half-bred Friesian bulls the progeny turned out to be good milkers. This seems to indicate that the sires in both cases were more prepotent than the dams, in spite of the fact that in the second case the sire was a half-bred Friesian. When $\frac{1}{4}$ European cows (Friesian or Ayrshire) were crossed with country bulls the results were poor, giving a $\frac{1}{8}$ cross averaging 6 pounds daily. When the same cows were crossed with a $\frac{1}{4}$ Friesian bull the results were good ; when crossed with pure Friesian bull it gave $\frac{5}{8}$ crosses averaging 28 lbs. daily. The $\frac{1}{4}$ Friesian bull had to have a half-bred Friesian bull as a sire. He could not be the descendant of a country sire and a half-bred Friesian dam in order to make any improvement. This all goes to prove that if one knows the breeding of his Friesian bulls, even if they are not pure bred, he can get fairly good results. Of course it is always safer to use the pure bred animal. If however the Holstein-Friesian proves to be worth while for breeding purposes it would be better for a beginner to start with a grade bull and then to follow up with a pure bred Friesian bull rather than delay until he can afford to buy a pure bred Friesian bull.

The best indigenous herd in India, which has been developed through careful selection for many years, has obtained an average of about 8,000 lbs. of milk per year. The foundation cows for this herd were obtained from great distances and were most carefully picked. Are we satisfied with an 8,000 or 10,000 lbs. average? Yes, at present, we are, but in the future we will not be. We must try for higher level, and I am doubtful if any indigenous breed even after many years of pure line breeding will pass the 8,000 to 10,000 lbs. level.

It may be that this first method of grading with pure bred Holstein-Friesian bulls as well as with other European bulls that have not been tried may prove unsatisfactory. In that case as far as using this method as a general policy to be recommended for all would be unwise. However, we must wait and see how the experiments now being carried on turn out before any general policy for cattle-breeders can be determined.

Experiments in the second method will take many years to work out. In the long run, however, a breed which can be produced according to Mendelian principles is sure to be satisfactory. It will take expert supervision and a great deal of time and money, but it would be time and money well spent.—*The Tropical Agriculturist*, Vol. LXX, No. 1.

A Short History of Sugar in India.

By Noel Deerr,

President of Sugar Technologists' Association of India.

The history of sugar in India can be traced back to pre-historic times and to mythological tradition and folklore. This alone indicates the great antiquity of the presence of the plant in India. The principal legend connects the creation of sugarcane with the holy man Vishvamitra. In this legend, Trishanku, a King of the solar race, appealed to his priest Vashishtha to transport him in bodily form to heaven or to the abode of Indra. On Vashishtha refusing to do this, Trishanku insulted the priest who laid a curse on Trishanku's family, condemning them to the caste of Chandalas for a thousand years. Vishvamitra, however, was able to transport Trishanku to heaven whence Indra promptly expelled him. Vishvamitra seeing this, arrested Trishanku midway and formed for him in mid-air a paradise in which he also created sugarcane. Eventually sugarcane was thrown down from this heaven for the use of mortal men.

The memory of this legend still remains green in Indian peasant life and annually is commemorated in the festival of the Dethawan which takes place 11 days after Dewali. In this festival sugarcane is cut

immediately before harvest begins and the first fruits of the crop are offered to Vishnu.

Sugarcane is mentioned in the more ancient historical writings of India. In the *Institute of Manu*, VIII, 341, appears the injunction that a twice-born man on a journey may, when his provisions are exhausted, take two sugarcanes from a field. Again in the *Institute*, V, 7, there appears a long list of foods to be avoided by Brahmans amongst which appears wheat mixed with butter, milk and sugar.

In the *Atharva Veda*, which consists mainly of Mantras, appears a charm to secure the love of a maiden which ends with the words "I have surrounded thee with a clinging sugarcane to remove aversion so that thou shalt not be averse to me"; and finally in the *Ramayana* sugar is mentioned among a list of special articles served at a regal banquet.

I wish I had sufficient knowledge of ancient Indian lore to introduce a discussion of the bearing of the Ikshvaku race on the history of sugarcane in ancient times of India. Some scholars interpret the Ikshvaku race as meaning the sugarcane race or family which had adopted the sugarcane as their crest or totem, but this view is disputed by others. An Indian gentleman to whom I referred the original draft of this address informs me that the Ikshvaku of the Vedas is distinct from the Ikshvaku of the Puranas, and accepting his statement it is apparent that the interpretation of various scholars is incorrect. I cannot, however, leave this subject without quoting the opening words of the Fo-Sho-Heng-Tsan-King (*Life of Buddha*) by Ma-Meng-Pu-Sa, which forms a part of the Chinese Canon of the Buddhist Scripture. These are: "There was a descendant of the Ikshvaku (sugarcane) family an invincible Sakya monarch pure in mind and unspotted in virtue called Suddhohana." And Suddhohana was the father of Gautama, the Buddha, and the region where the Ikshvaku race lived still remains one of the great sugarcane areas of the world. This region is that in which we are now holding our first meeting and quite close to several of our modern factories, for example, Barra, Pursa and Bubnowlie are sites which are definitely connected with incidents in the *Life and Travels of the Buddha*.

Leaving the India of myth, legend and tradition and coming to historic yet still ancient times, the first mention of sugar or rather of *gul* or *gur* is made by Panini, the great Indian grammarian, who flourished perhaps in the seventh century B.C. After him Charaka, who lived in the sixth century B.C. and was thus a contemporary of Gautama and Mahavira, describes various products of the same according to the degree of purification. The order was Kshudra Guda, Guda, Matsyandi, Khanda

and Sankara. The last mentioned product is mentioned by Charaka as nutritious and fattening, as healing wounds and as being an aphrodisiac. This mention of different products would indicate that at this early time some knowledge of refining was extant in India. Two centuries later, Chanakya, Minister of Chandragupta, and Susrata write of sugar and the sugarcane. The process of manufacture does not appear to have advanced beyond Chanakya's day, but on the other hand Susrata mentions no less than 12 varieties of cane and goes into detail on the properties of sugar in its various forms of sugarcane ; generally he says that it is sweet to the taste, has a cooling effect, increases the flow of urine and counteracts the sanguinary and bilious temperament of the body. He even goes further than this and differentiates between the effects of the various varieties of cane known to him. To the products of juice in its various forms he generally attributes demulcent, cooling, laxative and aphrodisiac properties and particularly notes its flesh-forming qualities and value as a food. As the article becomes more and more refined, he notes that its qualities become intensified.

There has been evidently knowledge of the cane and its products in Northern India for probably at least 3,000 years and from India a knowledge of sugar passed to China. The authorities on this point are rather confused and contradictory. There is no mention of sugar or of the cane in the Five Classics, and the first mention seems to be in the second century B.C., and the first detailed descriptions in the Nan-fang-ts'aomu-chuang of the 4th century A.D. Earlier than this, however, Ssu-ma-siang-ju, a poet of the second century A.D., wrote that sugar removed the after-effects of intoxication and in 286 A.D. it is on record that Fu Nan, that is to say, Behar, sent sugar as a tribute to China. In the Kuang-kun-gang-p'u, it is stated that the Emperor T'ai-tsung (627—650 A.D.) sent a man to Mo-ko-to (*i.e.*, Magada, now Patna) to learn how to make sugar, and this is probably the earliest record of visitations from itinerant chemists and engineers which, of recent years, have become so common. Elsewhere it is on record that in the time of Emperor Thang (766-780 A.D.) a wandering Indian Buddhist Priest (Tseon by name) showed the inhabitants of the province of Ssetchmen how to make sugar from the cane. The cane, however, must have reached China long before this, as Fa-Hien who reached India about 350 A.D. writes that on reaching the plains of Northern India bamboo, pomegranates and sugarcane were the only plants familiar to him. Just as the cane and knowledge of the art of sugar-making spread from the Ganges Valley to China, so also it spreads westward. The soldiers of Alexander the Great, 350 B.C., were the first Europeans to see the cane and to eat sugar (honey made without bees),

and thence mainly through Arab traders the cane gradually spread to Southern Europe. With this development we are not however concerned.

In India it is easy to see from the writings of Biruni, Ibn-Batutu, Marco Polo, and of the European mariners who first reached India by sea that a great industry with extensive commercial relations developed in India, but this phase of sugar history I must pass over and come down to recent times.

The development of sugar first of all in Madeira and the Canaries in the fifteenth century and in the New World in the 16th century served to supply the western world with sugar and although India still remained a producer she did not any longer appear as an exporter. The modern history of sugar in India begins in 1791. In that year occurred the Black Rebellion in Hayti and San Domingo, resulting in the massacre of almost all the white population and the disappearance of the then largest individual producer and exporter of sugar. The price of sugar rose rapidly, and the East India Company took advantage of the rise to export sugar to England. They did not enter the field as producers, but merely acted as merchants buying in the open market and exporting. A footnote in Macpherson's "Annals of Commerce," quoted below, gives the history of the first exportation. "In 1791 four parcels were imported from Bengal. The sugar was fair and dry so as to serve for loaf sugar for tea. Partly because of the scarcity and because some people who wished for the abolition of slavery wished to use sugar made by free people sold at 88*s.* 6*d.*—156*s.* 6*d.* per cwt. Notwithstanding the prodigious price, the Company lost money on the first parcel and on all four only gained 6 per cent.

This period of activity was, however, short-lived as other West Indian Islands took advantage of the obliteration of Hayti, and from now on to the end of the Napoleonic wars was the most prosperous period of the British West Indies, which now became the dominant sugar factory of the world.

The economic policy of the British Empire here begins to have influence on the sugar industry in India. There were two groups of producers, the West Indian merchants and planters, and the East India Company, and it was the former who appear to have been most influential, in that duties favouring the West Indian producer were in force for many years. In 1821, there was a modification of duties, and in 1836 East and West Indian sugars entered home markets on equal terms. This change in policy naturally produced violent protests from West Indian interests, particularly as they were faced with the dislocation of business following on the emancipation of the slaves. As a consequence of these changes no inconsiderable capital was invested in sugar in India. West Indian and

Mauritius planters were attracted to India, and it appeared that a substantial and stable industry was in process of establishment, so much so that by 1846, the export of sugar from India to Britain had reached 60,000 tons. The history of this revival is of interest and since it has apparently passed from the memory of the present generation, I take the opportunity to give a short resume here.

The industry developed in two forms; in one, European planters acquired or rented land and established combined plantations and factories according to the West Indian model. In these factories, as now, cane grown by the planters and cane purchased from peasant proprietors, was crushed. In the second refineries, operating in *gur* purchased in the open market, were erected and in some cases, as now, cane crushing and *gur* refining were carried on in the same factory.

The attempts to establish a sugar industry were mainly in that part of Bengal, now Behar, in the United Provinces of Agra and Oudh mainly in the districts of Basti and Gorakhpore and in Madras. Some of the places, where factories were started, were Azizpore, Motihari, Seersha, Barrah, Chakia, Belsund, Jummoah, Bogga, Gorakhpore and Roda, the last of which still survives. These were all on the West Indian plan and aimed at producing sugar direct from cane. The factory at Gorakhpore is of interest as it was started by Leonard Wray, the author of "The Practical Sugar Planter," a work which, after nearly 100 years, may still be read with benefit. These undertakings did not lack for enterprise; that at Jummoah, on the west bank of Bagmati in Champaran, installed a double crushing plant and vacuum pans which at that time represented very advanced practice. This concern also did pioneer work in introducing and experimenting with cane varieties amongst which were the Otaheite cane (brought to India by Sir William Leeman) the Red Bourbon, the China or Chinese cane (*Saccharum sinense* of Roxburgh), the Nagori, and other country canes. It is on record that from Otaheite as much as 60 maunds of sugar per acre was obtained. This plantation had, at one time, as much as 700 acres under cane divided between Otaheite, Red Bourbon and country cane. The principal partner in this enterprise was a Mr. Arthur Crooke. Another undertaking of no small size was that in which a certain Andrew Sym was interested at Padrauna.

Those enterprises which depended on *gur* refining appear to have been located in Bengal proper, and of these that at Dhoobah, Cossipore, Seebpore, Albion and Ballicoll seem to have been the largest. At Dhoobah upwards of £5,00,000 was, in all, expended and the factory which, in one year, turned out 7,000 tons of sugar was believed to be the largest and best equipped in the world. Of these factories, none to-day exists.

Cossipore of which the original owners were Hardman Howarth & Co. started operations on 26th December 1842, and only ceased to work a couple of years ago. The long existence of Cossipore may perhaps be connected with the evidence given before a Parliamentary Committee in 1848 by a Mr. Crooke who stated that "Mr. Hardman was a gentleman skilled in engineering who lived on his property (Cossipore) and worked like a slave"; and the general trend of Mr. Crooke's evidence seems to imply that he did not think this behaviour of Mr. Hardman was entirely to that gentleman's credit. At this period also were started in Madras the enterprises controlled by Messrs. Parry & Company which still exist to-day; and by Messrs. Binny & Co., who started the Aska Factory which, in 1865, developed the first cane sugar diffusion factory. This still exists as a diffusion plant and as such forms a unique incident in the technical history of cane sugar.

Another pioneer who appears on the stage at this period was S. H. Robinson who migrated from Mauritius to India. He was apparently an engineer and published in Calcutta in 1849 a very readable and for the period advanced treatise " The Bengal Sugar Planter". Some machinery supplied by him at this period still remains in operation in indigo factories, and in particular what was almost certainly the cane engine supplied to the Belsund concern is now operating the beating vats and after 80 years show little signs of wear. Hardly any trace of these factories, however, now exists and their sites even are forgotten, the only relics which may be found being occasionally old mill rollers used on tennis courts and golf greens.

In 1846, there was an unexpected change in the British tariff policy. The Cobden or Manchester School of Economists obtained control, free trade became a fetish and the purchase of raw products in the cheapest market became a dogma. On these principles slave-grown sugar was admitted to Great Britain on equal terms with that produced by free labour, and in a few years the industry, which had been built up in India, almost entirely disappeared.

It required the lapse of another 50 years for the revival of interest in sugar in India and this revival was associated with the fall in the price of indigo. The first sugar scheme of this period to be initiated was that of the India Development Company at Ottur in Behar. This pioneer enterprise did not meet with success. Shortly afterwards and in about 1900 the factories at Japaha, Pursa, Marhowrah, Barrah, Chakia and Purtabpore were started and all of these remain in existence to-day. Since then many other factories have been built, their distribution in India being :—

Behar and Orissa.—Eleven factories operating on cane, of which six also refine *gur* and two refine *gur* only.

United Provinces of Agra and Oudh.—Nine factories operating on cane, of which eight also refine *gur* and seven refine *gur* only.

Madras.—Three factories operating on cane, of which two also refine *gur* and three refine *gur* only.

Bombay.—Two factories operating on cane, of which one is silent.

Punjab.—Two *gur* refineries.

Burma.—One factory operating on cane only.

I estimate the capacity (not necessarily the output) of these factorie as follows :—

	Short tons sugar.
26 factories working on cane as from 1/12—30/4..	80,000
19 factories operating on *gur* as from 15/5—30/9..	30,000
14 factories operating on *gur* only	50,000
TOTAL ..	1,60,000

I regard the technical status of these factories as being in a transitional stage. There are some, which though small, can as far as efficiency is concerned, be compared with the best in any part of the world; there are others of but moderate efficiency, and yet others which I regret to have to say leave much to be desired, both in respect to plant and in respect to operation. As for the future I am of opinion that the present moment is opportune for us to show what can be done in the way of development. There is an industrious peasantry which has grown cane as a staple crop from before the dawn of history, there is a Government sympathetic to our aims, there is a vast market protected by tariff and by natural frontiers at the very door of our factories and, with these advantages, capital should not be hard to attract. It is on the technologists that the chief burden of developing the natural resources of India will lie. A mere placid contentment with mediocrity will not suffice and to merely follow where others lead will not establish a stable sugar industry in India. We should make it our aim to have our factories so well equipped and so well operated that our results may be at once the envy and despair of our competitors in foreign countries.—*The International Sugar Journal*, Vol. XXX, No. 351, pp. 131-38.

Agriculture in India.

India now-a-days is rarely without its Commission, and these follow one another in rapid succession. The most recent one reporting is the Royal Commission on Agriculture, which has been at work for the past

two years, somewhat overshadowed latterly by the Simon Commission. The short title is rather misleading, for the terms of reference cover much wider ground; these include the "present position of agricultural and rural economy in India" and the Commissioner is asked to make "recommendations and to promote the welfare and prosperity of the rural population." Specifically mentioned, besides agricultural and veterinary practice, are agricultural statistics, better crops and improvement in practice, dairy farming and breeding of stocks, as well as methods of transport and marketing, agricultural finance and credit. But the intention of His Majesty's Government is perhaps more clearly indicated by the composition of the Commission, which includes no member of the Indian Agricultural Service.

For those, then, who might naturally look for a careful survey of the many problems facing Indian agriculture, the report will be somewhat disappointing. For a study of such questions they will have to depend chiefly on the mass of evidence which is now being published. The Commission contents itself, so far as the improvement of agriculture is concerned, with some 50 to 60 pages, but devotes a large number of pages to the agricultural services and their organization, having among its members those eminently fitted for dealing with this.

The Commission, in its letter of submission, writes as follows:—

"Throughout our Report we have endeavoured to make plain our conviction that no substantial improvement in Agriculture can be effected unless the cultivator has the will to achieve a better standard of living and capacity, in terms of mental equipment and of physical health, to take advantage of the opportunities which science, wise laws, and good administrations may place at his disposal. Of all the factors making for prosperous agriculture, by far the most important is the outlook of the peasant himself." When all is said and done, however, we do not think that the requests in the terms of reference "in particular to investigate the measures now being taken for the promotion of agricultural research ....the introduction of new and better crops and improvement in agricultural practice," has received sufficient attention. The inclusion of experienced workers in these subjects would have strengthened the Commission, and rendered this part of its report more weighty and valuable.

The compact volume in which the report is printed runs to close on 900 pages, of which the first 100 are devoted to an unofficial summary, excellently written and of particular value to the general reader. We gather that the first step taken on landing in India was the preparation of the usual questionnaire which was very freely distributed. Replies to this numbered 783, and 395 witnesses were examined during the two

years. The mass of literature comprised of these written statements and the subsequent examinations should form a useful library on Indian agriculture, and the present conditions of the rural population.

The report opens with an introductory chapter on "The Village" the unit of Rural India, which is entirely different from anything in Great Britain. It consists in the main of a collection of mud houses huddled together like a flock of frightened sheep in the midst of the fields belonging to it. The arrangement dates from ancient times, and obviously makes for mutual protection, for the cultivators were defenceless against the bands of marauders. Besides this, the demands of their rulers varied from year to year and were sometimes crushing; and there was always the fear of famine if the monsoon failed. Selling the produce from their fields was non-existent in a small community all growing the same crops, and each cultivator was content with producing only the amount required for his family. Later, with added security under a settled Government, matters improved, and there was a new-found feeling of safety. The land was divided up and the rights of ownership examined and recorded, and for the first time land, irrespective of crops, acquired a value. Each member of the village knew what proportion of the produce was his own—but the arrangement of centuries remained unaltered. Of the 500,000 villages in India, most are still untouched by metalled roads or railways, and are thus cut off from one another by impassable paths during the rains.

There is in India a marked absence of large-scale farming. All agricultural practices are dependent on the stated periods of the monsoons, and work on the land in the long dry season becomes impossible. Thus for half the year the cultivator has his time on his hands. It is always hard to change the old-time customs, but not the least problem engaging the attention of the Commission appears to be that of placing the cultivator in a position, by the most varied ameliorations, to make use of this idle time.

In the second chapter there is a summary history of the efforts at applying scientific agriculture to India, from the enlistment of twelve American cotton planters in 1839 "to teach the cultivators to grow and clean cotton," and the celebrated order placed in England in 1863 by the Madras Government for "a steam plough, steam harrows and cultivators, seed drills and horse hoes, threshing machines and winnowers, chaff cutters and water lifts," to the establishment in 1903 by Lord Curzon of the Indian Agricultural Department. When the constitutional changes occurred in 1919, all departments connected with rural welfare were 'transferred' from the Government of India to the local governors, each

acting through a minister. This of course included agriculture, with the exception of the central research stations for all India.

In Chapter III, the Commission, dissatisfied with the incoherence of the arrangement, proposes a new organization for agricultural research. This scheme, although the Commission is not quite unanimous in matters of detail, appears to be well thought out and of value. At present the agricultural departments in the provinces are independent of one another and of the central research institutes which are under the control of the Agricultural Adviser to the Government of India. This lack of connection between all-India and provincial departments is, and always had been, an anomaly, and the new organization is designed to bring them into closer relations. For this purpose the establishment of an Imperial Council of Agricultural Research, with a lump sum of 50 lakhs of rupees as endowment, is recommended; the primary function of the Council will be to co-ordinate agricultural and veterinary research in India with that in other parts of the British Empire and foreign countries.

(To be continued.)

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